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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

MINERAL RESOURCES
OF THE
UNITED STATES

CALENDAR YEAR
1907

PART I—METALLIC PRODUCTS

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WASHINGTON
GOVERNMENT PRINTING OFFICE
1908

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MINERAL RESOURCES OF THE UNITED STATES FOR 1907—PART I.

INTRODUCTION.

CHARACTER AND SCOPE OF REPORT.

The arrangement and scope of this report are practically the same as in the twenty-three preceding reports of the series Mineral Resources of the United States. Each report records the development of the mineral industries of the United States since the time covered by the preceding number of the series; the reports should therefore be consulted together. Each chapter is a census of the productive features of the industry under discussion. The statistics of the imports and exports of minerals, which form an essential part of the volume, are obtained through the courtesy of the Chief of the Bureau of Statistics, Department of Commerce and Labor.

The summary gives the principal statistical information recorded in this report.

In presenting these statistics all unnecessary duplication has been avoided. The coke product, for example, discussed in the following pages and amounting to 40,779,564 short tons, valued at $111,539,126, is excluded from the tabular statement, as the quantity and value of the coal used in its manufacture are included in the statistics of coal production. Similarly, white lead, red lead, litharge, and orange mineral, whose average aggregate value for the last ten years has exceeded $15,000,000, are not given in the table, the base from which they are made being included in the output of pig lead. Zinc oxide, zinc lead, sublimed blue lead, and sublimed white lead, made directly from the ores, and consequently not included in spelter or lead production, are tabulated. The production of pig iron and its value are given in the table as the best means of presenting the statistics of the production of iron in the first marketable condition, the output of iron ores being shown in a footnote. In like manner the value of clay products is given as representing the first marketable condition of the clay resources of the country. Inflation of valuation and all unnecessary duplication are thus avoided as far as practicable.

In accordance with a change in the law (sundry civil appropriation act, approved May 27, 1908) governing the publication of this report, it will henceforth appear in two parts, the first part containing the statistics of the metallic products, and the second part the statistics of the nonmetallic products of the country.

As heretofore, the publication of this report has been anticipated to a great extent by the issue in advance, in pamphlet form, of the several chapters which compose it.

ACKNOWLEDGMENTS.

Except as noted above, and in a few isolated instances where some other well-established agency already exists by which the statistics are collected accurately, the figures are obtained directly from the producers, and it is impossible to acknowledge here, otherwise than by brief mention, the invaluable assistance which has been freely rendered by them and by the voluntary contributions of many local experts. The technical press, besides affording much information concerning new mining enterprises, has been largely drawn upon for prices, market reports, and new technical processes.

SUMMARY OF THE MINERAL PRODUCTION OF THE UNITED STATES IN 1907.

COMPILED BY W. T. THOM.

GENERAL REMARKS.

The varied character of the units of measurement employed in the mineral industry makes it impossible to compare the outputs of the several minerals, except in the value of the products. The figures given in the following summary show a continuation of the activity in the mineral industries of the United States noted in 1900, 1901, 1902, and 1903, though the value of the output for 1904 was almost 9 per cent less than that for 1903; the value in 1905 was about 9 per cent greater than that for 1903.

In 1906, for the second time, the total value of our mineral production exceeded the enormous sum of $1,500,000,000, and in 1907, for the first time, the still greater sum of $2,000,000,000 was exceeded.

The exact figures for 1907 are $2,069,289,196, as compared with $1,904,007,034 in 1906, with $1,625,135,835 in 1905, with $1,363,072,345 in 1904, and with $1,491,928,980 in 1903—a gain in 1907 over 1906 of $165,282,162, or 8.68 per cent; over 1905 of $444,153,361, or 27.33 per cent; over 1904 of $706,216,851, or 51.81 per cent; over 1903 of $577,360,216, or 38.70 per cent.

As heretofore, iron and coal are the most important of our mineral products. The value of the iron in 1907 was $529,958,000; the value of the coal was $614,798,898. The fuels increased from $652,398,476 in 1906 to $787,772,482 in 1907—a gain of $135,374,006, or 20.75 per cent. Anthracite coal showed an increase in value of $31,666,362, from $131,917,694 in 1906 to $163,584,056 in 1907. The increase in value of the bituminous coal output over 1906 was $70,052,727, from $381,162,115 in 1906 to $451,214,842 in 1907—a combined increase in value of coal of $101,719,089, or 19.83 per cent.

The gain of $165,282,162 in the total value of our mineral production is due to gains in both metallic and nonmetallic products, the metallic products showing an increase from $886,110,856 in 1906 to $903,024,005 in 1907, a gain of $16, 913,149, and the nonmetallic products showing an increase from $1,017,696,178 in 1906 to $1,166,165,191 in 1907, a gain of $148,469,013. To these products should be added estimated unspecified products, including molybdenum, nickel, titanium, and other mineral products, valued at $100,000, making a total mineral production for 1907 of $2,069,289,196.

METALS.

Iron and steel.—Twenty-one States produced pig iron in 1907, as against 20 in 1906, 20 in 1905, 20 in 1904, 22 in 1903, and 22 in 1902.

The total production of pig iron in 1907 was 25,781,361 long tons, as against 25,307,191 long tons in 1906, 22,992,380 long tons in 1905, 16,497,033 long tons in 1904, and 18,009,252 tons in 1903. The production of 1907 shows an increase in quantity of 474,170 long tons, or about 1.87 per cent, over the production of 1906, and an increase in value from $505,700,000 to $529,958,000, amounting to $24,258,000, or 4.80 per cent. The average price per long ton of pig iron increased from $19.98 in 1906 to $20.56 in 1907. The average prices per long ton in recent years have been as follows: 1905, $16.63; 1904, $14.13; 1903, $19.12.

Iron ores.—The production of iron ores in 1907 amounted to 51,720,619 long tons, as compared with 47,749,728 long tons in 1906, with 42,526,133 long tons in 1905, with 27,644,330 long tons in 1904, and with 35,019,308 long tons in 1903. The value at the mines of the ore mined in 1907 was $131,996,147, as compared with $100,597,106 in 1906, and with $75,165,604 in 1905. As in the eight preceding years, the production of iron ores in the United States in 1907 was never equaled by that of any other country.

Manganese ores.—The production of manganese ores was 3,146 long tons, valued at $29,466, in 1904; 4,118 long tons, valued at $36,214, in 1905; 6,921 long tons, valued at $88,132, in 1906; and 5,604 long tons, valued at $63,369, in 1907. The average price per ton was $9.37 in 1904, $8.80 in 1905, $12.73 in 1906, and $11.31 in 1907. Manganiferous ores, carrying from 20 to 40 per cent of manganese, were produced to the extent of 103,844 long tons, valued at $259,473, as against 41,300 long tons, valued at $122,400, in 1906.

Gold.—The production of gold increased from 3,892,480 ounces, valued at $80,464,700, in 1904, to 4,265,742 ounces, valued at $88,180,700, in 1905, and to 4,565,333 ounces, valued at $94,373,800, in 1906, and decreased in 1907 to 4,374,827 ounces, valued at $90,435,700, a loss in 1907 of 190,506 ounces in quantity and of $3,938,100 in value.

Silver.—The production of silver increased in quantity from 57,682,800 ounces in 1904 to 56,101,600 ounces in 1905, and to 56,517,900 ounces in 1906, and decreased to 56,514,700 ounces in 1907—a loss of 3,200 ounces. It increased in commercial value from $33,456,000 in 1904 to $34,221,976 in 1905, and to $38,256,400 in 1906, and decreased to $37,299,700 in 1907—a loss of $956,700.

Copper.—The production of copper increased from 812,537,267 pounds, valued at $105,629,845, in 1904, to 901,907,843 pounds, valued at $139,795,716, in 1905, and to 917,805,682 pounds, valued at $177,595,888, in 1906, and decreased in 1907 to 868,996,491 pounds, valued at $173,799,300.

Lead.—The production of lead in 1907 was 365,166 short tons, as against 350,153 short tons in 1906, 302,000 short tons in 1905, 307,000 short tons in 1904, and 282,000 short tons in 1903. The value of the production in 1907 was $38,707,596, as compared with $39,917,442 in 1906, with $28,690,000 in 1905, with $26,402,000 in 1904, and with $23,520,000 in 1903.

Zinc.—The production of zinc in 1907 was 223,745 short tons, as against 199,694 short tons in 1906, 203,849 short tons in 1905, 186,702 short tons in 1904, and 159,219 short tons in 1903. The value of the zinc production in 1907 was $26,401,910, as compared with $24,362,668 in 1906, with $24,054,182 in 1905, with $18,670,200 in 1904, and with $16,717,995 in 1903.

Bauxite.—In 1907 the production of bauxite was 97,776 long tons, valued at $480,330, as compared with 75,332 long tons, valued at $368,311, in 1906; with 48,129 long tons, valued at $240,292, in 1905; with 47,661 long tons, valued at $235,704, in 1904; and with 48,087 long tons, valued at $171,306, in 1903.

Aluminum.—The consumption of aluminum during 1907 was 17,211,000 pounds, valued at $4,926,948, as against 14,910,000 pounds, valued at $4,262,286, in 1906; against 11,347,000 pounds, valued at $3,246,300, in 1905, and 8,600,000 pounds, valued at $2,477,000, in 1904.

Quicksilver.—The production of quicksilver during 1907 amounted to 21,567 flasks, as against 26,238 flasks (of 76½ avoirdupois pounds net; 75 avoirdupois pounds net after June, 1904) in 1906, as compared with 30,451 flasks in 1905, with 34,570 flasks in 1904, with 35,620 flasks in 1903. The value of the quicksilver produced in 1907 was $828,931, as compared with $958,634 in 1906, with $1,103,120 in 1905, with $1,503,795 in 1904, and with $1,544,934 in 1903. California reported 17,431 flasks, as against 20,310 flasks in 1906, 24,635 flasks in 1905, 29,217 flasks in 1904, and 30,526 flasks in 1903, and Texas reported 3,686 flasks, as against 4,761 flasks in 1906, 4,723 flasks in 1905, 5,336 flasks in 1904, and 5,029 flasks in 1903. Utah reported 450 flasks, as against 1,164 flasks in 1906, and Oregon did not report any production against 3 flasks in 1906.

Chromic iron ore.—California was the only State producing chromite during 1907, the quantity being 290 long tons, valued at $5,640, as compared with 107 long tons, valued at $1,800, in 1906; with 22 long tons, valued at $375, in 1905; with 123 long tons, valued at $1,845, in 1904, and with 150 long tons, valued at $2,250, in 1903.

Molybdenum.—There was a small commercial production of molybdenum in 1907, as in 1906 and 1905. The value of molybdenum ores fluctuates very greatly.

Nickel.—There was no production of metallic nickel reported in 1907, as in 1906 and 1905, only a small quantity of nickel and cobalt ore being reported as sold. In 1904 the output was 24,000 pounds, as against a production of 114,200 pounds in 1903, and of 5,748 pounds in 1902. The value in 1904 was $11,400, as against $45,900 in 1903, and $2,701 in 1902. The imports of nickel in 1907 were valued at $2,243,026, as against $1,902,367 in 1906, $1,962,131 in 1905, $1,121,491 in 1904, and $1,493,889 in 1903.

Rutile.—A small production of rutile from Virginia was reported in 1907.

Tungsten.—The commercial production of concentrated tungsten ores during 1907 amounted to 1,640 short tons, valued at $890,048, as against 928 short tons, valued at $348,867, in 1906; 803 short tons, valued at $268,676, in 1905; 740 short tons, valued at $184,000, in 1904; and 292 short tons, valued at $43,639, in 1903.

Uranium and vanadium.—The production of uranium and vanadium minerals in 1907, as in 1906, is included under unspecified products. The production in 1905 was valued at $375, as against $10,600 in 1904 and $5,625 in 1903.

Tantalum.—A very small production of tantalum in 1907 was reported from South Dakota.

Platinum.—The production of platinum from domestic ores in 1907 was 357 ounces, valued at $10,589, as compared with 1,439 ounces, valued at $45,189, in 1906; with 318 ounces, valued at $5,320, in 1905;

with 200 ounces, valued at $4,160, in 1904; and with 110 ounces, valued at $2,080, in 1903. The average price per ounce for 1907 was $29.66.

Antimony.—The production of antimony in 1907 was 2,022 short tons, valued at $622,046, as compared with 1,766 short tons, valued at $602,949, in 1906; with 3,240 short tons, valued at $705,787, in 1905; with 3,057 short tons, valued at $505,524, in 1904; and with 3,128 short tons, valued at $548,433, in 1903.

Bismuth.—No production of bismuth was reported in 1907. The marketed production of bismuth ore in 1906 was 8,334 pounds, valued at $12,500; in 1905 it was 24,405 pounds, valued at $4,187; in 1904 it was 5,184 pounds, valued at $314.

Tin.—There was a very small production of metallic tin in South Dakota in 1907, which, with concentrates from Alaska, from South Dakota, and from the North Carolina-South Carolina deposits, was valued at $33,285, against $35,600 in 1906.

Cadmium.—Cadmium was produced by the Grasselli Chemical Company, of Cleveland, Ohio, in 1906; no production was reported for 1907.

FUELS.

Coal.—For the second time in the history of the United States the production of coal in 1907 reached a total of over 400,000,000 short tons, showing an actual output of 480,363,424 tons of 2,000 pounds, valued at $614,798,898. Of this total, the output of anthracite coal amounted to 76,432,421 long tons (equivalent to 85,604,312 short tons), which, as compared with the production of 63,645,010 long tons in 1906, was an increase of 12,787,411 long tons, or over 20 per cent. The value of anthracite coal at the mines in 1907 was $163,584,056, as against $131,917,694 in 1906, $141,879,000 in 1905, $138,974,020 in 1904, and $152,036,448 in 1903. The average price of the marketed anthracite coal sold during the year at the mines was $2.35 per long ton, as against $2.30 per long ton in 1906, $2.25 in 1905, $2.35 in 1904, and $2.50 in 1903.

The output of bituminous coal (which includes semianthracite and all semibituminous and lignite coals) amounted in 1907 to 394,759,112 short tons, valued at $451,214,842, as compared with 342,874,867 short tons, valued at $381,162,115, in 1906; with 315,062,785 short tons, valued at $334,658,294, in 1905; with 278,659,689 short tons, valued at $305,397,001, in 1904; and with 282,749,348 short tons, valued at $351,687,933, in 1903. The increase in the production of bituminous coal in 1907 over 1906 was therefore 51,884,245 short tons in quantity and $70,052,727 in value. The average price of bituminous coal per ton at the mines during 1907 was $1.14 as against $1.11 in 1906, $1.06 in 1905, $1.10 in 1904, and $1.24 per ton in 1903, the highest price recorded by the survey.

Coke.—The coke production of the United States in 1907, which included the output, 5,607,899 short tons, from 3,811 retort or by-product ovens, amounted to 40,779,564 short tons, as compared with 36,401,217 short tons in 1906, with 32,231,129 short tons in 1905, with 23,661,106 short tons in 1904, and with 25,274,281 short tons in 1903. The increase in quantity in 1907 from 1906 was 4,378,347 short tons, or 12.02 per cent. The total value was $111,539,126, as against $91,608,034 in 1906, a gain of $19,931,092, or about 22 per cent. The average price per ton in 1907 was $2.74, against $2.52

in 1906. The average output from the by-product ovens in 1907 was 1,472 tons per oven, against an average of 386.8 tons per oven from the beehive ovens.

Natural gas.—The value of the natural gas produced in 1907 was $52,866,835, as compared with $46,873,932 in 1906, with $41,562,855 in 1905, with $38,496,760 in 1904, and with $35,807,860 in 1903.

Gas, coke, tar, and ammonia.—The aggregate value of all the products obtained from the distillation of coal in gas works and retort ovens in 1905 was $56,684,972, as against $51,157,736 in 1904, and $47,830,600 in 1903. No report was prepared for 1906. The aggregate value in 1907 was $73,573,004.

Petroleum.—The total production of crude petroleum in the United States in 1907 was 166,095,335 barrels, as against 126,493,936 barrels in 1906, against 134,717,580 barrels in 1905, 117,080,960 barrels in 1904, and 100,461,337 barrels in 1903, an increase in 1907 of 39,601,399 barrels, or 31 per cent, over theproduction of 1906. Among the noteworthy changes in production in 1907 were gains, as compared with 1906, of over 24,000,000 barrels in the Mid-Continent field, of about 20,000,000 barrels in the Illinois field, and of over 6,000,000 barrels in California.

The value of crude petroleum produced during 1907 was $120,106,749, or 72.3 cents per barrel, as against $92,444,735, or 73.1 cents per barrel, in 1906; against $84,157,399, or 62.47 cents per barrel, in 1905; against $101,175,455, or 86.41 cents per barrel, in 1904; and against $94,694,050, or 94.26 cents per barrel, in 1903.

STRUCTURAL MATERIALS.

Cement.—The total production of hydraulic cement in the United States in 1907 was 52,230,342 barrels, valued at $55,903,851, as compared with 51,000,445 barrels, valued at $55,302,277, in 1906; with 40,102,308 barrels, valued at $35,931,533, in 1905; with 31,675,257 barrels, valued at $26,031,920, in 1904; and with 29,899,140 barrels, valued at $31,931,341, in 1903. The Portland cement production in 1907 was 48,785,390 barrels, valued at $53,992,551, as compared with 46,463,424 barrels, valued at $52,466,186, in 1906; with 35,246,812 barrels, valued at $33,245,867, in 1905; with 26,505,881 barrels, valued at $23,355,119, in 1904; and with 22,342,973 barrels, valued at $27,713,319, in 1903—an increase in quantity in 1907, as compared with 1906, of 2,321,966 barrels, and in value of $1,526,365. The production of natural cement in 1907 was 2,887,700 barrels, valued at $1,467,302, as compared with 4,055,797 barrels, valued at $2,423,170, in 1906; with 4,473,049 barrels, valued at $2,413,052, in 1905; with 4,866,331 barrels, valued at $2,450,150, in 1904; and with 7,030,271 barrels, valued at $3,675,520, in 1903—a decrease in 1907 of about 29 per cent in quantity and of about 39 per cent in value. The production of puzzolan cement in 1907 amounted to 557,252 barrels, valued at $443,998, as against 481,224 barrels, valued at $412,921, in 1906; against 382,447 barrels, valued at $272,614, in 1905; 303,045 barrels, valued at $226,651, in 1904; and 525,896 barrels, valued at $542,502, in 1903.

Clay products.—The value of all clay products in 1907, as reported to this office, was $158,942,369, as against $161,032,722 in 1906, $149,697,188 in 1905, $131,023,248 in 1904, and $131,062,421 in 1903. The brick and tile products in 1907 were valued at $128,798,895, as against $129,591,838 in 1906, $121,778,294 in 1905, $105,864,978 in 1904, and $105,626,369 in 1903. The pottery products were valued in 1907 at $30,143,474, as against $31,440,884 in 1906, $27,918,894 in 1905, $25,158,270 in 1904, and $25,436,052 in 1903.

The commercial production of clay mined and sold in 1907 by those not manufacturing the clay themselves was valued at $3,448,548, as against $3,245,256 in 1906, $2,768,006 in 1905, $2,320,162 in 1904, and $2,594,042 in 1903.

Lime.—The production of lime in 1907 was 3,084,799 short tons, valued at $12,640,512, as against 3,198,087 short tons, valued at $12,480,653 in 1906; against 2,984,100 short tons, valued at $10,941,680, in 1905, and against 2,707,809 short tons, valued at $9,951,456, in 1904. The average price per short ton was $3.90 in 1906 and $4.10 in 1907.

Sand-lime brick.—The production of sand-lime brick in 1907 was valued at $1,225,769, as against $1,170,005 in 1906, $972,064 in 1905, $463,128 in 1904, and $155,040 in 1903.

Slate.—The production of slate in 1907 was valued at $6,019,220, as against $5,668,346 in 1906, $5,496,207 in 1905, $5,617,195 in 1904, and $6,256,885 in 1903.

Stone.—The value of all kinds of stone produced in the United States during 1907 amounted to $71,105,805, as compared with $66,378,794 in 1906, with $63,798,748 in 1905, with $58,765,715 in 1904, and with $57,433,141 in 1903.

Included under stone is the limestone used for fluxing in blast furnaces, which in 1907 was 17,119,297 long tons, valued at $9,144,489, as compared with 16,077,202 long tons, valued at $7,612,692, in 1906; with 15,387,891 long tons, valued at $7,004,265, in 1905; with 10,657,038 long tons, valued at $4,702,768, in 1904; and with 12,029,719 long tons, valued at $5,423,732, in 1903.

ABRASIVE MATERIALS.

Artificial abrasives.—The total production of artificial abrasives in 1907 amounted to 14,632,000 pounds, valued at $1,027,246.

Alundum or artificial corundum.—The production of alundum by the Norton Emery Wheel Company amounted in 1906 to 4,712,000 pounds, valued at $282,720, an average of 6 cents per pound, as compared with 3,612,000 pounds manufactured in 1905, valued at $252,840, an average of 7 cents per pound, and with 4,020,000 pounds manufactured in 1904.

Carborundum.—The production of carborundum in 1906 was 6,225,300 pounds, as against 5,596,000 pounds in 1905, 7,060,380 pounds in 1904, 4,759,890 pounds in 1903, and 3,741,500 pounds in 1902. The value of the carborundum varies from 7 to 10 cents a pound.

Corundum and emery.—The combined production of corundum and emery in 1907 amounted to 1,069 short tons, valued at $12,294, as against 1,160 short tons, valued at $44,310, in 1906; 2,126 short tons, valued at $61,464, in 1905; 1,916 short tons, valued at $56,985, in 1904; 2,542 short tons, valued at $64,102, in 1903; and 4,251 short tons, valued at $104,605, in 1902.

Crushed steel.—The production of crushed steel in 1906 was 837,000 pounds, as against 612,000 pounds in 1905, 790,000 pounds in 1904, 755,000 pounds in 1903, and 735,000 pounds in 1902.

Abrasive quartz and feldspar.—In 1907 the production of abrasive quartz and feldspar amounted to 17,435 short tons, valued at $126,582, as against 24,082 short tons, valued at $121,671, in 1906; against 19,039 short tons, valued at $88,118, in 1905; against 31,940 short tons, valued at $74,850, in 1904; and 8,938 short tons, valued at $76,908, in 1903.

Garnet.—The production of abrasive garnet in the United States during 1907 amounted to 7,058 short tons, valued at $211,686, as against 4,650 short tons, valued at $157,000, in 1906; 5,050 short tons, valued at $148,095, in 1905; 3,854 short tons, valued at $117,581, in 1904; and 3,950 short tons, valued at $132,500, in 1903. The average price for the 1907 production was about $30 per ton.

Grindstones.—The total value of all kinds of grindstones and pulpstones produced during 1907 was $896,022, as against $744,894 in 1906, $777,606 in 1905, $881,527 in 1904, $721,446 in 1903, and $667,431 in 1902.

Infusorial earth and tripoli.—In 1907 the value of the infusorial earth and tripoli produced was $104,406. In 1906 the production of infusorial earth and tripoli amounted to 8,099 short tons, valued at $72,108, as against 10,977 short tons, valued at $64,637, in 1905; 6,274 short tons, valued at $44,164, in 1904; and 9,219 short tons, valued at $76,273, in 1903.

Millstones and buhrstones.—The value of the production of millstones and buhrstones in 1907 was $31,741, as against $48,590 in 1906, $37,974 in 1905, $37,338 in 1904, and $52,552 in 1903.

Oilstones and whetstones.—The production of oilstones and whetstones in 1907 was valued at $264,188. The value rose from $188,985 in 1904 to $244,546 in 1905 and to $268,070 in 1906.

Pumice.—The production of pumice amounted in 1907 to 8,112 short tons, valued at $33,818, as against 12,200 short tons, valued at $16,750, in 1906; 1,832 short tons, valued at $5,540, in 1905; 1,530 short tons, valued at $5,421, in 1904; and 885 short tons, valued at $2,665, in 1903.

CHEMICAL MATERIALS.

Arsenious oxide.—The domestic production of arsenious oxide (white arsenic) in 1907 was 3,502,000 pounds, valued at $163,000, as against 1,474,000 pounds, valued at $63,460, in 1906; 1,507,386 pounds, valued at $35,210, in 1905; 72,413 pounds, valued at $2,185, in 1904; and 1,222,000 pounds, valued at $36,691, in 1903. The imports of white arsenic, metallic arsenic, and arsenic sulphide in 1907 were valued at $574,998, as against $350,045 in 1906.

Borax.—The reported returns for 1907 gave an aggregate production of crude borax of 52,850 short tons, valued at $1,121,520, as against 58,173 short tons, valued at $1,182,410, in 1906; 46,334 short tons, valued at $1,019,154, in 1905; 45,647 short tons, valued at $698,810, in 1904; and 34,430 short tons, valued at $661,400, in 1903.

Bromine.—The production of bromine in 1907, including the bromine contained in potassium bromide, amounted to 1,379,496 pounds, valued at $195,281, as compared with 1,283,250 pounds, valued at $165,204, in 1906; with 1,192,758 pounds, valued at $178,914, in 1905; with 897,100 pounds, valued at $269,130, in 1904; and with 598,500 pounds, valued at $167,580, in 1903.

Fluorspar.—The total commercial production of fluorspar in 1907 was 49,486 short tons, valued at $287,282, as compared with 40,796 short tons, valued at $244,025, in 1906; with 57,385 short tons, valued at $362,488, in 1905; with 36,452 short tons, valued at $234,755, in 1904; and with 42,523 short tons, valued at $213,617, in 1903.

Gypsum.—The output of crude gypsum in 1907 was 1,751,748 short tons, valued in its first marketable condition at $4,942,264, as compared with 1,540,585 short tons, valued at $3,837,975, in 1906; with 1,043,202 short tons, valued at $3,029,227, in 1905; with 940,917 short tons, valued at $2,784,325, in 1904; and with 1,041,704 short tons, valued at $3,792,943, in 1903. The greatly increased production of late years is attributable to the largely increased use of wall plaster and of plaster of Paris in large modern buildings.

Lithium minerals.—The production of lithium minerals in 1907 was 530 short tons, valued at $11,000, as against 383 short tons, valued at $7,411, in 1906; as against 79 short tons, valued at $1,412, in 1905; 577 short tons, valued at $5,155, in 1904; and 1,155 short tons, valued at $23,425, in 1903.

Marls.—The production of marls in the United States in 1907 was 14,091 short tons, valued at $8,429, as against 19,104 short tons, valued at $7,341, in 1906; in 1905 it was 38,026 short tons, valued at $16,494; and in 1904 it was 18,989 short tons, valued at $13,145.

Phosphate rock.—The total commercial production of phosphate rock reported to the Survey in 1907 amounted to 2,265,343 long tons, valued at $10,653,558, as compared with 2,080,957 long tons, valued at $8,579,437, in 1906; with 1,947,190 long tons, valued at $6,763,403, in 1905; with 1,874,428 long tons, valued at $6,580,875, in 1904; and with 1,581,576 long tons, valued at $5,319,294, in 1903. The total quantity of phosphate rock reported as mined during 1907 was 2,356,486 long tons, as against 2,001,394 long tons mined in 1906, against 2,138,309 long tons mined in 1905, and 1,991,169 long tons mined in 1904.

Salt.—The salt product includes salt in the form of brine used in large quantities for the manufacture of soda ash, sodium bicarbonate, caustic soda, and other sodium salts. The domestic production of salt in 1907 amounted to 29,704,128 barrels of 280 pounds, valued at $7,439,551, as compared with 28,172,380 barrels, valued at $6,658,350, in 1906; with 25,966,122 barrels, valued at $6,095,922, in 1905; with 22,030,002 barrels, valued at $6,021,222, in 1904; and with 18,968,089 barrels, valued at $5,286,988, in 1903.

Sulphur and pyrite.—The domestic production of sulphur in 1907 was 293,106 long tons, valued at $5,142,850, as against 294,153 long tons, valued at $5,096,678, in 1906; the production of pyrite was 247,387 long tons, valued at $794,949, as against 261,422 long tons, valued at $931,305, in 1906. The combined production of sulphur and pyrite for the manufacture of sulphuric acid amounted to 434,677 long tons, valued at $4,645,052, in 1905; to 334,373 long tons, valued at $3,478,568, in 1904; and to 233,127 long tons, valued at $1,109,818, in 1903.

PIGMENTS.

Barytes.—The production of crude barytes in 1907 was 89,621 short tons, valued at $291,777, as compared with 50,231 short tons, valued at $160,367, in 1906; with 48,235 short tons, valued at $148,803, in 1905; with 65,727 short tons, valued at $174,958, in 1904; and with 50,397 short tons, valued at $152,150, in 1903.

Cobalt oxide.—A production of cobalt oxide was reported from Oregon and Missouri in 1907. No production of cobalt oxide was reported in 1905 and 1906. In 1904 it was 22,000 pounds, valued at $42,600; in 1903 it was 120,000 pounds, valued at $228,000; in 1902 it was 3,730 pounds, valued at $6,714.

Mineral paints.—The commercial production of mineral paints in 1907 amounted to 71,973 short tons, valued at $2,979,158, as compared with 66,033 short tons, valued at $2,161,461, in 1906; with 70,355 short tons, valued at $1,932,048, in 1905; with 64,592 short tons, valued at $1,448,551, in 1904; and with 56,262 short tons, valued at $500,922, in 1903.

Zinc oxide.—The production of zinc oxide in 1907 amounted to 71,784 short tons, valued at $6,490,660, as compared with 74,680 short tons, valued at $5,999,375, in 1906; with 68,603 short tons, valued at $5,520,240, in 1905; with 63,363 short tons, valued at $4,808,482, in 1904; and with 62,962 short tons, valued at $4,801,718, in 1903.

MISCELLANEOUS.

Asbestos.—The asbestos commercially produced in the United States in 1907 was obtained from deposits in Georgia, with small quantities from Arizona and California. The total commercial production was 653 short tons, valued at $11,899, as against 1,695 short tons, valued at $28,565, in 1906; against 3,109 short tons, valued at $42,975, in 1905; and against 1,480 short tons, valued at $25,740, in 1904.

Asphalt.—Under this title are included the various bitumens or hydrocarbons not discussed elsewhere under the heading "Petroleum." The commercial production in 1907 was 223,861 short tons, valued at $2,826,489, as against 138,059 short tons, valued at $1,290,340, in 1906; 115,267 short tons, valued at $758,153, in 1905; 108,572 short tons, valued at $879,836, in 1904; and 101,255 short tons, valued at $1,005,446, in 1903.

Feldspar.—The production of feldspar in 1907 was 84,549 short tons, valued at $499,069, as against 75,656 short tons, valued at $401,531, in 1906; 35,419 short tons, valued at $226,157, in 1905; 45,188 short tons, valued at $266,326, in 1904; and 41,891 short tons, valued at $256,733, in 1903.

Fibrous talc.—This variety of talc, or soapstone, occurs in but one locality in the United States—Gouverneur, St. Lawrence County, N. Y. It is used principally as makeweight in the manufacture of paper. In 1907 the production was 67,800 short tons, valued at $626,000 as against 61,672 short tons, valued at $557,200, in 1906; against 56,500 short tons, valued at $445,000, in 1905; 64,005 short tons, valued at $507,400, in 1904; and 60,230 short tons, valued at $421,600, in 1903.

Fuller's earth.—As reported to the Survey, the production of fuller's earth in 1907 was 32,851 short tons, valued at $291,773, as against 32,040 short tons, valued at $265,400, in 1906; against 25,178 short tons, valued at $214,497, in 1905; 29,480 short tons, valued at $168,500, in 1904; and 20,693 short tons, valued at $190,277, in 1903. The imports in 1907 were valued at $122,221, as against $108,695 in 1906.

Glass sand.—The production of glass sand in 1907 was 1,187,296 short tons, valued at $1,250,067, as against 1,089,430 short tons, valued at $1,208,788, in 1906; against 1,060,334 short tons, valued at $1,107,730, in 1905; 858,719 short tons, valued at $796,492, in 1904; and 823,044 short tons, valued at $855,828, in 1903.

Graphite.—The commercial production of crystalline graphite during 1907 amounted to 4,947,840 pounds, valued at $171,149, as compared with 5,887,982 pounds, valued at $238,064, in 1906; with 6,036,567 pounds, valued at $237,572, in 1905; with 5,681,177 pounds, valued at $238,447, in 1904, and with 4,538,155 pounds, valued at $154,170, in 1903. The production of amorphous graphite in 1907 was 26,803 short tons, valued at $125,821, as compared with 16,853 short tons, valued at $102,175, in 1906; with 21,953 short tons, valued at $80,639, in 1905; with 16,927 short tons, valued at $82,925, in 1904; and with 16,591 short tons, valued at $71,384, in 1903. The production of artificial graphite in 1907 was 6,590,000 pounds, valued at $481,239, the average price being 7.30 cents per pound, as compared with 5,074,757 pounds, valued at $337,204, the average price being 6.64 cents per pound, in 1906; with 4,591,550 pounds, valued at $313,980, the average price being 6.84 cents per pound, in 1905; with 3,248,000 pounds, valued at $217,790, the average price being 6.71 cents per pound, in 1904; and with 2,620,000 pounds, valued at $178,670, in 1903, when the average price was 6.82 cents per pound. The imports of graphite in 1907 were valued at $1,777,389, as against $1,554,212 in 1906, and $983,034 in 1905.

Magnesite.—The production of crude magnesite in the United States continues to be limited to California. During the year 1907 the commercial production reported was 7,561 short tons, valued at $22,683, as against 7,805 short tons, valued at $23,415, in 1906; 3,933 short tons, valued at $15,221, in 1905; 2,850 short tons, valued at $9,298, in 1904; and 3,744 short tons, valued at $10,595, in 1903.

Mica.—The total production of mica in 1907 was 1,060,182 pounds of sheet mica, valued at $349,311, and 3,025 short tons of scrap mica, valued at $42,800, as against 1,423,100 pounds of sheet mica, valued at $252,248, and 1,489 short tons of scrap mica, valued at $22,742, in 1906; and against 924,875 pounds of sheet mica, valued at $160,732, and 1,126 short tons of scrap mica, valued at $17,856, in 1905.

Mineral waters.—The total production of mineral waters in 1907 was 52,060,520 gallons, valued at $7,331,503, as compared with 48,108,580 gallons, valued at $8,028,387, in 1906; with 47,590,081 gallons, valued at $6,811,611, in 1905; and with 50,723,500 gallons, valued at $7,198,450, in 1904.

Monazite and zircon.—The production of monazite is confined exclusively to North Carolina and South Carolina, about five-sixths being obtained from the former State. In 1907 the production (including a small quantity of zircon) was 548,152 pounds of concentrates, valued at $65,800, as against 847,275 pounds of concentrates, valued at $152,560, in 1906. In 1905 the production (including small quantities of zircon and columbite) amounted to 1,352,418 pounds, valued at $163,908, as compared with 745,999 pounds (including small quantities of zircon, columbite, and gadolinite), valued at $85,038, in 1904; and with 865,000 pounds, valued at $65,200 (including 3,000 pounds of zircon, valued at $570), in 1903.

Peat.—There was no commercial production of peat in 1906 and 1907. Considerable experimental work has been done in the production of peat bricks for use as fuel under boilers, and in the practical tests of machine peat.

Potassium salts.—There was no production of potassium salts in the United States in 1907; the imports were valued at $7,038,817, as against $5,941,217 in 1906.

Precious stones.—The value of the gems and precious stones found in the United States in 1907 was reported as $471,300, as against $208,000 in 1906, $326,350 in 1905, $324,300 in 1904, and $307,900 in 1903. The pearls produced in 1907 were valued at $264,500, as against $381,000 in 1906.

Quartz.—The production of quartz in 1907 was 22,977 short tons, valued at $157,094, as against 66,697 short tons, valued at $243,012, in 1906; 51,145 short tons, valued at $104,109, in 1905; 52,270 short tons, valued at $100,590, in 1904; and 55,233 short tons, valued at $156,947, in 1903.

Sand and gravel.—The production of sand for molding, building, engine, furnace, and other purposes, and of gravel, reported in 1907, was 40,664,622 short tons, valued at $13,242,002, as against 31,842,572 short tons, valued at $11,489,420, in 1906; 22,144,633 short tons, valued at $10,115,915, in 1905; and 9,821,009 short tons, valued at $4,951,607, in 1904.

Talc and soapstone.—Exclusive of the production of fibrous talc from Gouverneur, N. Y., the production of talc and soapstone in 1907 amounted to 72,010 short tons, valued at $905,047, as compared with 58,972 short tons, valued at $874,356, in 1906; with 40,134 short tons, valued at $637,062, in 1905; with 27,184 short tons, valued at $433,331, in 1904; and with 26,671 short tons, valued at $418,460, in 1903.

MINERAL PRODUCTS OF THE UNITED STATES IN 1906 AND 1907.

From the tabular statement headed "Mineral products of the United States in 1906 and 1907," including also the tables for the years 1880 to 1907, all unnecessary duplication has been excluded. The manufactured coke product, amounting in 1907 to 40,779,564 short tons and valued at $111,539,126, is excluded, as the quantity and value of the coal used in its manufacture are included in the statistics of coal production. Similarly, white lead, red lead, lithophone, Venetian red, litharge, and orange mineral, whose average aggregate value for the last ten years has largely exceeded $10,000,000, are not given in the table, the base from which they are made being included in the output of pig lead. Zinc white or zinc oxide, zinc lead, sublimed blue lead, and sublimed white lead, on the other hand, made directly from the ores and consequently not included in spelter or lead production, are tabulated. The production of pig iron and its value are given in the table as the best means of presenting the statistics of the production of iron in the first marketable condition, the value of iron ores being excluded. Similarly, the value of the products of the clay industries is given as being the first marketable condition of the greater part of the clay produced, although the production and value of the clay mined and sold in the raw state by clay miners to manufacturers of clay are elsewhere shown separately, but are not included in the tabular statement, in order to avoid duplication.

The figures for gold and silver for 1906 and 1907 are the official figures agreed upon by the United States Geological Survey and the Director of the Mint.

Mineral products of the United

	Product.	1906.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron,[a] spot value[b] .... [c]long tons..	25,307,191	$505,700,000
2	Silver, commercial value[d] .... troy ounces..	56,517,900	38,256,400
3	Gold, coining value[e] .... do....	4,565,333	94,373,800
4	Copper, value at New York City .... pounds..	917,805,682	177,595,888
5	Lead,[f] value at New York City .... short tons..	350,153	39,917,442
6	Zinc, value at New York City .... do....	199,694	24,362,668
7	Quicksilver, value at San Francisco .... [g]flasks..	26,238	958,634
8	Aluminum, value at Pittsburg .... pounds..	[h]14,910,000	4,262,286
9	Antimony,[i] value at San Francisco .... short tons..	1,766	602,949
10	Nickel,[j] value at Philadelphia .... pounds..	....	(k)
11	Tin .... do....	(l)	35,600
12	Platinum, value (crude) at New York City .... troy ounces..	1,439	45,189
13	Total value of metallic products	....	886,110,856
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal[m] .... short tons..	342,874,867	381,162,115
15	Pennsylvania anthracite .... long tons..	63,645,010	131,917,694
16	Natural gas	....	46,873,932
17	Petroleum .... [n]barrels..	126,493,936	92,444,735
18	Clay products[o]	....	161,032,722
19	Cement .... [p]barrels..	51,000,445	55,302,277
20	Lime .... short tons..	3,198,087	12,480,653
21	Sand-lime brick	....	1,170,005
22	Slate	....	5,668,346
23	Stone[q]	....	66,378,794
24	Corundum and emery .... short tons..	1,160	44,310
25	Abrasive quartz and feldspar .... do....	24,082	121,671
26	Garnet for abrasive purposes .... do....	4,650	157,000
27	Grindstones	....	744,894
28	Infusorial earth and tripoli .... short tons..	8,099	72,108
29	Millstones	....	48,590
30	Oilstones, etc	....	268,070
31	Arsenious oxide .... pounds..	1,474,000	63,460
32	Borax (crude) .... short tons..	58,173	1,182,410
33	Bromine .... pounds..	1,283,250	165,204
34	Fluorspar .... short tons..	40,796	244,025
35	Gypsum .... do....	1,540,585	3,837,975
36	Lithium minerals .... do....	383	7,411
37	Marls .... do....	19,104	7,341
38	Phosphate rock .... long tons..	2,080,957	8,579,437
39	Pyrite .... do....	261,422	931,305
40	Sulphur .... do....	294,153	5,096,678
41	Salt .... [r]barrels..	28,172,380	6,658,350
42	Barytes (crude) .... short tons..	50,231	160,367
43	Cobalt oxide .... pounds..	....	(k)
44	Mineral paints[s] .... short tons..	66,033	2,161,461
45	Zinc white .... do....	74,680	5,999,375
46	Abestos .... do....	1,695	28,565
47	Asphalt .... do....	138,059	1,290,340
48	Bauxite .... long tons..	75,332	368,311
49	Chromic iron ore .... do....	107	1,800
50	Feldspar .... short tons..	75,656	401,531

[a] Production of iron ore—1898: 19,433,716 long tons; value at mines, $22,060,887. 1899: 24,683,173 long tons; value at mines, $34,999,077. 1900: 27,553,161 long tons; value at mines, $66,590,504. 1901: 28,887,479 long tons; value at mines, $49,256,245. 1902: 35,554,135 long tons; value at mines, $65,412,950. 1903: 35,019,308 long tons; value at mines, $66,328,415. 1904: 27,644,330 long tons; value at mines, $43,186,741. 1905: 42,526,133 long tons; value at mines, $75,165,604. 1906: 47,749,728 long tons; value at mines, $100,597,106. 1907: 51,720,619 long tons; value at mines, $131,996,147. Statistics for iron ore and for value of pig iron are collected by the survey; statistics for output of pig iron are furnished by the American Iron and Steel Association.

[b] By "spot" value is meant value at the point of production.

[c] Long tons are tons of 2,240 avoirdupois pounds; short tons are tons of 2,000 avoirdupois pounds.

[d] Average price per troy ounce in 1906 was 67 cents; in 1907 it was 66 cents.

[e] Prior to 1905, coining value, $20.6718 per troy ounce; in 1905, coining value, $20.671834; in 1906 and 1907, coining value, $20.671834625323.

[f] The product from domestic ores only.

[g] Of 76½ avoirdupois pounds net; of 75 avoirdupois pounds net since June, 1904.

[h] Consumption in 1904, 1905, 1906, and 1907.

[i] Includes antimony smelted from imported ores and antimony contained in hard lead.

[j] Includes nickel in copper-nickel alloy and in exported ore and matte.

[k] Included under unspecified.

States in 1906 and 1907.

1907.		Increase (+) or decrease (−) in 1907.		Percentage of increase (+) or decrease (−) in 1907.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
25,781,361	$529,958,000	+ 474,170	+$24,258,000	+ 1.87	+ 4.80	1
56,514,700	37,299,700	− 3,200	− 956,700	− .006	− 2.50	2
4,374,827	90,435,700	− 190,506	− 3,938,100	− 4.17	− 4.17	3
868,996,491	173,799,300	−48,809,191	− 3,796,588	− 5.32	− 2.14	4
365,166	38,707,596	+ 15,013	− 1,209,846	+ 4.29	− 3.03	5
223,745	26,401,910	+ 24,051	+ 2,039,242	+12.04	+ 8.37	6
21,567	828,931	− 4,671	− 129,703	−17.80	− 13.53	7
h 17,211,000	4,926,948	+ 2,301,000	+ 664,662	+15.43	+ 15.59	8
2,022	622,046	+ 256	+ 19,097	+14.49	+ 3.17	9
	(k)					10
(l)	33,285	....	2,315	....	− 6.50	11
357	10,589	− 1,082	− 34,600	−75.19	− 76.57	12
....	903,024,005	....	+ 16,913,149	....	+ 1.91	13
394,759,112	451,214,842	+51,884,245	+ 70,052,727	+15.13	+ 18.38	14
76,432,421	163,584,056	+12,787,411	+ 31,666,362	+20.09	+ 24.00	15
....	52,866,835	....	+ 5,992,903	....	+ 12.79	16
166,095,335	120,106,749	+39,601,399	+ 27,662,014	+31.31	+ 29.92	17
....	158,942,369	....	− 2,090,353	....	− 1.30	18
52,230,342	55,903,851	+ 1,229,897	+ 601,574	+ 2.41	+ 1.09	19
3,084,799	12,640,512	113,288	+ 159,859	− 3.54	+ 1.28	20
....	1,225,769	....	+ 55,764	....	+ 4.77	21
....	6,019,220	....	+ 350,874	....	+ 6.19	22
....	71,105,805	....	+ 4,727,011	....	+ 7.12	23
1,069	12,294	− 91	− 32,016	− 7.84	− 72.25	24
17,435	126,582	− 6,647	+ 4,911	−27.60	+ 4.04	25
7,058	211,686	+ 2,408	+ 54,686	+51.78	+ 34.83	26
....	896,022	....	+ 151,128	....	+ 20.29	27
....	104,406	....	+ 32,298	....	+ 44.79	28
....	31,741	....	− 16,849	....	− 34.68	29
....	264,188	....	− 3,882	....	− 1.45	30
3,502,000	163,000	+ 2,028,000	+ 99,540	+137.58	+156.85	31
52,850	1,121,520	− 5,323	− 60,890	− 9.15	− 5.15	32
1,379,496	195,281	+ 96,246	+ 30,077	+ 7.50	+ 18.21	33
49,486	287,282	+ 8,690	+ 43,257	+ 21.30	+ 17.73	34
1,751,748	4,942,264	+ 211,163	+ 1,104,289	+ 13.71	+ 28.77	35
530	11,000	+ 147	+ 3,589	+ 38.38	+ 48.43	36
14,091	8,429	− 5,013	+ 1,088	− 26.24	+ 14.82	37
2,265,343	10,653,558	+ 184,386	+ 2,074,121	+ 8.86	+ 24.18	38
247,387	794,949	− 14,035	− 136,356	− 5.37	− 14.64	39
293,106	5,142,850	− 1,047	+ 46,172	− .36	+ .91	40
29,704,128	7,439,551	+ 1,531,748	+ 781,201	+ 5.44	+ 11.73	41
89,621	291,777	+ 39,390	+ 131,410	+ 78.42	+ 81.94	42
(k)						43
71,973	2,979,158	+ 5,940	+ 817,697	+ 9.00	+ 37.83	44
71,784	6,490,660	− 2,896	+ 491,285	− 3.88	+ 8.19	45
653	11,899	− 1,042	− 16,666	− 61.47	− 58.34	46
223,861	2,826,489	+ 85,802	+ 1,536,149	+ 62.15	+119.05	47
97,776	480,330	+ 22,444	+ 112,019	+ 29.79	+ 30.41	48
290	5,640	+ 183	+ 3,840	+171.03	+213.33	49
84,549	499,069	+ 8,893	+ 97,538	+ 11.75	+ 24.29	50

[l] Nineteen short tons of high-grade concentrates shipped to England from South Carolina in 1903. In 1904 about 142 short tons of concentrates from South Carolina, South Dakota, and Alaska shipped to England. In 1905 no production. In 1906, 2,500 pounds of metallic tin, 55 short tons of concentrates from Alaska, and 14 short tons of concentrates from North Carolina and South Carolina.

[m] Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania. Coke—1902: 25,401,730 short tons; value at ovens, $63,339,167. 1903: 25,274,281 short tons; value at ovens, $66,498,664. 1904: 23,661,106 short tons; value at ovens, $46,144,941. 1905: 32,231,129 short tons; value at ovens, $72,476,196. 1906: 36,401,217 short tons; value at ovens, $91,608,034. 1907: 40,779,564 short tons; value at ovens, $111,539,126.

[n] Of 42 gallons.

[o] Value of clay mined and sold as unmanufactured clay. 1898: $1,384,766. 1899: Census returns, $1,645,328. 1900: $1,840,377. 1901: $2,576,932. 1902: $2,061,072. 1903: $2,594,042. 1904: $2,320,162. 1905: $2,768,006. 1906: $3,245,256. 1907: $3,448,548.

[p] Of 380 pounds net.

[q] Includes limestone for iron flux, but not including grindstones.

[r] Of 280 pounds net. Value is for net product exclusive of cost of packages.

[s] Includes metallic paint, ocher, umber, mortar colors, sienna, ground slate, shales, sublimed blue lead, sublimed white lead, and zinc lead.

Mineral products of the United States

	Product.	1906.	
		Quantity.	Value.
	NONMETALLIC (SPOT VALUES)—continued.		
51	Fibrous talc ....short tons..	61,672	$557,200
52	Fuller's earth ....do....	32,040	265,400
53	Glass sand ....do....	1,089,430	1,208,788
54	Graphite (crystalline) ....pounds..	5,887,982	238,064
	Graphite (amorphous) ....short tons..	16,853	102,175
55	Magnesite ....do....	7,805	23,415
56	Manganese ores ....long tons..	6,921	88,132
	Manganiferous ores ....do....	41,300	122,400
57	Mica (sheet) ....pounds..	1,423,100	252,248
	Mica (scrap) ....short tons..	1,489	22,742
58	Mineral waters ....gallons sold..	48,108,580	8,028,387
59	Monazite and zircon ....pounds..	847,275	152,560
60	Precious stones	....	[a] 589,000
61	Pumice stone ....short tons..	12,200	16,750
62	Quartz ....do....	66,697	243,012
63	Rutile	....	([b])
64	Sand, molding, building, etc., and gravel ....short tons..	31,842,572	11,489,420
65	Talc and soapstone ....do....	58,972	874,356
66	Tungsten ....do....	928	348,867
67	Uranium and vanadium ....do....	....	([b])
68	Total value of nonmetallic mineral products	....	1,017,696,178
69	Total value of metallic products	....	886,110,856
70	Estimated value of mineral products unspecified [b]	....	200,000
71	Grand total	....	1,904,007,034

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[a] Includes pearls valued at $381,000 in 1906 and at $264,500 in 1907.

[b] Includes nitrate of soda, carbonate of soda, sulphate of soda, and alum clays used by paper manufacturers; and molybdenum, nickel and cobalt, tantalum, titanium, uranium, and vanadium, valued together at $31,945.

in 1906 and 1907—Continued.

1907.		Increase (+) or decrease (−) in 1907.		Percentage of increase (+) or decrease (−) in 1907.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
67,800	$626,000	+ 6,128	+ $68,800	+ 9.94	+ 12.35	51
32,851	291,773	+ 811	+ 26,373	+ 2.53	+ 9.94	52
1,187,296	1,250,067	+ 97,866	+ 41,279	+ 8.98	+ 3.41	53
4,947,840	171,149	− 940,142	− 66,915	− 15.97	− 28.11	54
26,803	125,821	+ 9,950	+ 23,646	+ 59.04	+ 23.14	
7,561	22,683	− 244	− 732	− 3.13	− 3.13	55
5,604	63,369	− 1,317	− 24,763	− 19.03	− 28.10	56
103,844	259,473	+ 62,544	+ 137,073	+151.44	+111.99	
1,060,182	349,311	− 362,918	+ 97,063	− 25.50	+ 38.48	57
3,025	42,800	+ 1,536	+ 20,058	+103.16	+ 88.20	
52,060,520	7,331,503	+3,951,940	− 696,884	+ 8.21	− 8.68	58
548,152	65,800	− 299,123	− 86,760	− 35.30	− 56.87	59
	a 735,800		+ 146,800		+ 24.92	60
8,112	33,818	− 4,088	+ 17,068	− 33.50	+101.90	61
22,977	157,094	− 43,720	− 85,918	− 65.55	− 35.36	62
	(b)					63
40,664,622	13,242,002	+8,822,050	+ 1,752,582	+ 27.71	+ 15.25	64
72,010	905,047	+ 13,038	+ 30,691	+ 22.11	+ 3.51	65
1,640	890,048	+ 712	+ 541,181	+ 76.72	+155.13	66
	(b)					67
	1,166,165,191		+148,469,013		+ 14.59	68
	903,024,005		+ 16,913,149		+ 1.91	69
	100,000		− 100,000		− 50.00	70
	2,069,289,196		+165,282,162		+ 8.68	71

Mineral products of the United States

	Product.	1880.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron, value at Philadelphia ... long tons..	3,375,912	$89,315,569
2	Silver, commercial value ... troy ounces..	30,318,700	34,717,000
3	Gold, coining value ... do....	1,741,500	36,000,000
4	Copper, value at New York City ... pounds..	60,480,000	11,491,260
5	Lead, value at New York City ... short tons..	97,825	9,782,500
6	Zinc, value at New York City ... do....	23,239	2,277,432
7	Quicksilver, value at San Francisco ... flasks..	59,926	1,797,780
8	Nickel, value at Philadelphia ... pounds..	233,893	257,282
9	Aluminum, value at Pittsburg ... do....		
10	Antimony, value at San Francisco ... short tons..	50	10,000
11	Platinum (crude) value at San Francisco ... troy ounces..	100	400
12	Total value of metallic products		185,649,163
	NONMETALLIC (SPOT VALUES).		
13	Bituminous coal ... short tons..	38,242,641	53,443,718
14	Pennsylvania anthracite ... long tons..	25,580,189	42,196,678
15	Stone		18,356,055
16	Petroleum ... barrels..	26,286,123	24,183,233
17	Lime ... do....	28,000,000	19,000,000
18	Natural gas		
19	Cement ... barrels..	2,072,943	1,852,707
20	Salt ... do....	5,961,060	4,829,566
21	Phosphate rock ... long tons..	211,377	1,123,823
22	Limestone for iron flux ... do....	4,500,000	3,800,000
23	Mineral waters ... gallons sold..	2,000,000	500,000
24	Zinc white ... short tons..	10,107	763,738
25	Potters' clay ... do....	28,877	200,457
26	Mineral paints ... do....	3,604	135,840
27	Borax ... pounds..	3,692,443	277,233
28	Gypsum ... short tons..	90,000	400,000
29	Grindstones		500,000
30	Fibrous talc ... short tons..	4,210	54,730
31	Pyrite ... long tons..	2,000	5,000
32	Soapstone ... short tons..	8,441	66,665
33	Manganese ores ... long tons..	5,761	86,415
34	Asphalt ... short tons..	444	4,440
35	Precious stones		100,000
36	Bromine ... pounds..	404,690	114,752
37	Corundum ... short tons..	1,044	29,280
38	Barytes (crude) ... do....	20,000	80,000
39	Graphite ... pounds..		49,800
40	Millstones		200,000
41	Oilstones, etc.[a] ... pounds..	420,000	8,000
42	Marls ... short tons..	1,000,000	500,000
43	Flint ... long tons..	20,000	80,000
44	Fluorspar ... short tons..	4,000	16,000
45	Chromic iron ore ... long tons..	2,288	27,808
46	Infusorial earth ... short tons..	1,833	45,660
47	Feldspar ... long tons..	12,500	60,000
48	Mica ... pounds..	81,669	127,825
49	Cobalt oxide ... do....	7,251	24,000
50	Slate ground as a pigment ... short tons..	1,000	10,000
51	Sulphur ... do....	600	21,000
52	Asbestos ... do....	150	4,312
53	Rutile ... pounds..	100	400
54	Lithographic stone ... short tons..		
55	Total value of nonmetallic mineral products		173,279,135
56	Total value of metallic products		185,649,163
57	Estimated value of mineral products unspecified		6,000,000
58	Grand total		364,928,298

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[a] Prior to 1889 quantity and value are for rough stone quarried; since 1890 they are for finished product.

for the calendar years 1880–1907.

1881.		1882.		1883.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,144,254	$87,029,334	4,623,323	$106,336,429	4,595,510	$91,910,200	1
33,257,800	37,657,500	36,196,900	41,105,900	35,732,800	39,618,400	2
1,678,612	34,700,000	1,572,187	32,500,000	1,451,250	30,000,000	3
71,680,000	12,175,600	91,646,232	16,038,091	117,151,795	18,064,807	4
117,085	11,240,160	132,890	12,624,550	143,957	12,322,719	5
26,800	2,680,000	33,765	3,646,620	36,872	3,311,106	6
60,851	1,764,679	52,732	1,487,042	46,725	1,253,632	7
265,668	292,235	281,616	309,777	58,800	52,920	8
....	....	....	....	83	875	9
50	10,000	60	12,000	60	12,000	10
100	400	200	600	200	600	11
....	187,549,908	....	214,061,009	....	196,547,259	12
48,179,475	60,224,344	60,861,190	76,076,487	68,531,500	82,237,800	13
28,500,016	64,125,036	31,358,264	70,556,094	34,336,469	77,257,055	14
....	20,000,000	....	21,000,000	....	20,000,000	15
27,661,238	25,448,339	30,510,830	24,065,988	23,449,633	25,790,252	16
30,000,000	20,000,000	31,000,000	21,700,000	32,000,000	19,200,000	17
....	....	....	215,000	....	475,000	18
2,500,000	2,000,000	3,250,000	3,672,750	4,190,000	4,293,500	19
6,200,000	4,200,000	6,412,373	4,320,140	6,192,231	4,211,042	20
266,734	1,980,259	332,077	1,992,462	378,380	2,270,280	21
6,000,000	4,100,000	3,850,000	2,310,000	3,814,273	1,907,136	22
3,700,000	700,000	5,000,000	800,000	7,529,423	1,119,603	23
10,000	700,000	10,000	700,000	12,000	840,000	24
28,000	280,000	33,000	240,000	32,841	230,000	25
6,000	100,000	7,000	105,000	7,000	84,000	26
4,046,000	304,461	4,236,291	338,903	6,500,000	585,000	27
85,000	350,000	100,000	450,000	90,000	420,000	28
....	500,000	....	700,000	....	600,000	29
5,000	60,000	6,000	75,000	6,000	75,000	30
10,000	60,000	12,000	72,000	25,000	137,500	31
7,000	75,000	6,000	90,000	8,000	150,000	32
4,895	73,425	4,532	67,980	6,155	92,325	33
2,000	8,000	3,000	10,500	3,000	10,500	34
....	110,000	....	150,000	....	207,050	35
300,000	75,000	250,000	75,000	301,100	72,204	36
500	80,000	500	80,000	550	100,000	37
20,000	80,000	20,000	80,000	27,000	108,000	38
400,000	30,000	425,000	34,000	575,000	46,000	39
....	150,000	....	200,000	....	150,000	40
500,000	8,580	600,000	10,000	600,000	10,000	41
1,000,000	300,000	1,080,000	540,000	972,000	486,000	42
25,000	100,000	25,000	100,000	25,000	100,000	43
4,000	16,000	4,000	20,000	4,000	20,000	44
2,000	30,000	2,500	30,000	3,000	60,000	45
1,000	10,000	1,000	8,000	1,000	5,000	46
14,000	70,000	14,000	70,000	14,100	71,112	47
100,000	250,000	100,000	250,000	114,100	285,000	48
8,280	25,000	11,653	32,046	1,096	2,795	49
1,000	10,000	2,000	24,000	2,000	24,000	50
600	21,000	600	21,000	1,000	27,000	51
200	7,000	1,200	30,000	1,100	30,000	52
200	700	500	1,800	550	2,000	53
50	1,000	....	....	....	....	54
....	206,783,144	....	231,340,150	....	243,822,214	55
....	187,549,908	....	214,061,009	....	196,547,259	56
....	6,500,000	....	6,500,000	....	6,500,000	57
....	400,833,052	....	451,901,159	....	446,869,473	58

Mineral products of the United States for

	Product.	1884.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron, value at Philadelphia ... long tons	4,097,868	$73,761,624
2	Silver, commercial value ... troy ounces	37,743,800	41,921,300
3	Gold, coining value ... do	1,489,950	30,800,000
4	Copper, value at New York City ... pounds	145,221,934	17,789,687
5	Lead, value at New York City ... short tons	139,897	10,537,042
6	Zinc, value at New York City ... do	38,544	3,422,707
7	Quicksilver, value at San Francisco ... flasks	31,913	936,327
8	Nickel, value at Philadelphia ... pounds	64,550	48,412
9	Aluminum, value at Pittsburg ... do	150	1,350
10	Antimony, value at San Francisco ... short tons	60	12,000
11	Platinum (crude), value at San Francisco ... troy ounces	150	450
12	Total value of metallic products		179,230,899
	NONMETALLIC (SPOT VALUES).		
13	Bituminous coal ... short tons	73,730,539	77,417,066
14	Pennsylvania anthracite ... long tons	33,175,756	66,351,512
15	Stone		19,000,000
16	Petroleum ... barrels	24,218,438	20,595,966
17	Lime ... do	37,000,000	18,500,000
18	Natural gas		1,460,000
19	Brick clay		
20	Clay (all other than brick) ... short tons	39,200	270,000
21	Cement ... barrels	4,000,000	3,720,000
22	Salt ... do	6,514,937	4,197,734
23	Phosphate rock ... long tons	431,779	2,374,784
24	Limestone for iron flux ... do	3,401,930	1,700,965
25	Mineral waters ... gallons sold	10,215,328	1,459,143
26	Zinc white ... short tons	13,000	910,000
27	Mineral paints ... do	7,000	84,000
28	Borax ... pounds	7,000,000	490,000
29	Gypsum ... short tons	90,000	390,000
30	Grindstones		570,000
31	Fibrous talc ... short tons	10,000	110,000
32	Pyrite ... long tons	35,000	175,000
33	Soapstone ... short tons	10,000	200,000
34	Manganese ores ... long tons	10,180	122,160
35	Asphalt ... short tons	3,000	10,500
36	Precious stones		222,975
37	Bromine ... pounds	281,100	67,464
38	Corundum ... short tons	600	108,000
39	Barytes (crude) ... do	25,000	100,000
40	Graphite ... pounds		
41	Millstones		150,000
42	Oilstones, etc.[a] ... pounds	800,000	12,000
43	Marls ... short tons	875,000	437,500
44	Flint ... long tons	30,000	120,000
45	Fluorspar ... short tons	4,000	20,000
46	Chromic iron ore ... long tons	2,000	35,000
47	Infusorial earth ... short tons	1,000	5,000
48	Feldspar ... long tons	10,900	55,112
49	Mica ... pounds	147,410	368,525
50	Colbalt oxide ... do	2,000	5,100
51	Slate ground as a pigment ... short tons	2,000	20,000
52	Sulphur ... do	500	12,000
53	Asbestos ... do	1,000	30,000
54	Rutile ... pounds	600	2,000
55	Lithographic stone ... short tons		
56	Total value of nonmetallic mineral products		221,879,506
57	Total value of metallic products		179,230,899
58	Estimated value of mineral products unspecified		5,000,000
59	Grand total		406,110,405

[a] Prior to 1889 quantity and value are for rough stone quarried; since 1890 they are for finished product.

the calendar years 1880–1907—Continued.

1885.		1886.		1887.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,044,425	$64,712,400	5,683,329	$95,195,760	6,417,148	$121,925,800	1
39,909,400	42,503,500	39,694,000	39,482,400	41,721,600	40,887,200	2
1,538,373	31,801,000	1,686,788	34,869,000	1,603,049	33,136,000	3
170,962,607	18,292,999	161,235,381	16,527,651	185,227,331	21,115,916	4
129,412	10,469,431	130,629	12,200,749	145,700	13,113,000	5
40,688	3,539,856	42,641	3,752,408	50,340	4,782,300	6
32,073	979,189	29,981	1,060,000	33,825	1,429,000	7
277,904	179,975	214,992	127,157	205,566	133,200	8
283	2,550	3,000	27,000	18,000	59,000	9
50	10,000	35	7,000	75	15,000	10
250	187	50	100	448	1,838	11
....	172,491,087	....	203,249,225	....	236,598,254	12
64,840,668	82,347,648	73,707,957	78,481,056	87,887,360	98,004,656	13
34,228,548	76,671,948	34,853,077	76,119,120	37,578,747	84,552,181	14
....	19,000,000	....	19,000,000	....	25,000,000	15
21,847,205	19,198,243	28,064,841	19,996,313	28,278,866	18,877,094	16
40,000,000	20,000,000	....	....	....	....	17
....	4,857,200	....	10,012,000	....	15,817,500	18
....	....	....	6,200,000	....	7,000,000	19
40,320	275,000	44,800	325,000	48,160	340,000	20
4,150,000	3,492,500	4,500,000	3,990,000	6,692,744	5,674,377	21
7,038,653	4,825,345	7,707,081	4,736,585	7,831,962	4,093,846	22
437,856	2,846,064	430,549	1,872,936	480,558	1,836,818	23
3,356,956	1,678,478	4,717,163	2,830,297	5,377,000	3,226,200	24
9,148,401	1,312,845	8,950,317	1,284,070	8,259,609	1,261,463	25
15,000	1,050,000	18,000	1,440,000	18,000	1,440,000	26
3,950	43,575	18,800	315,000	22,000	330,000	27
8,000,000	480,000	9,778,290	488,915	11,000,000	550,000	28
90,405	405,000	95,250	428,625	95,000	425,000	29
....	500,000	....	250,000	....	224,400	30
10,000	110,000	12,000	125,000	15,000	160,000	31
49,000	220,500	55,000	220,000	52,000	210,000	32
10,000	200,000	12,000	225,000	12,000	225,000	33
23,258	190,281	30,193	277,636	34,524	333,844	34
3,000	10,500	3,500	14,000	4,000	16,000	35
....	209,900	....	119,056	....	163,600	36
310,000	89,900	428,334	141,350	199,087	61,717	37
600	108,000	645	116,190	600	108,000	38
15,000	75,000	10,000	50,000	15,000	75,000	39
327,883	26,231	415,525	33,242	416,000	34,000	40
....	100,000	....	140,000	....	100,000	41
1,000,000	15,000	1,160,000	15,000	1,200,000	16,000	42
875,000	437,500	800,000	400,000	600,000	300,000	43
30,000	120,000	30,000	120,000	32,000	128,000	44
5,000	22,500	5,000	22,000	5,000	20,000	45
2,700	40,000	2,000	30,000	3,000	40,000	46
1,000	5,000	1,200	6,000	3.000	15,000	47
13,600	68,000	14,900	74,500	10,200	61,200	48
92,000	161,000	40,000	70,000	70,000	142,250	49
68,723	65,373	35,000	36,878	18,340	18,774	50
1,975	24,687	....	....	....	....	51
715	17,875	2,500	75,000	3,000	100,000	52
300	9,000	200	6,000	150	4,500	53
600	2,000	600	2,000	1,000	3,000	54
....	....	....	....	....	....	55
....	241,312,093	....	230,088,769	....	270,989,420	56
....	172,491,087	....	203,249,225	....	236,598,254	57
....	5,000,000	....	800,000	....	800,000	58
....	418,803,180	....	434,137,994	....	508,387 674	59

Mineral products of the United States for

	Product.	1888.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron, value at Philadelphia..........long tons..	6,489,738	$107,000,000
2	Silver, commercial value..........troy ounces..	45,792,700	43,045,100
3	Gold, coining value..........do....	1,604,478	33,167,500
4	Copper, value at New York City..........pounds..	231,270,622	33,833,954
5	Lead, value at New York City..........short tons..	151,919	13,399,256
6	Zinc, value at New York City..........do....	55,903	5,500,855
7	Quicksilver, value at San Francisco..........flasks..	33,250	1,413,125
8	Aluminum, value at Pittsburg..........pounds..	19,000	65,000
9	Antimony, value at San Francisco..........short tons..	100	20,000
10	Nickel, value at Philadelphia..........pounds..	204,328	127,632
11	Tin..........do....	....	....
12	Platinum (crude), value at San Francisco..........troy ounces..	500	2,000
13	Total value of metallic products..........	....	237,574,422
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal..........short tons..	102,039,838	101,860,529
15	Pennsylvania anthracite..........long tons..	41,624,611	89,020,483
16	Stone..........	....	25,500,000
17	Petroleum..........barrels..	27,612,025	17,947,620
18	Natural gas..........	....	22,629,875
19	Brick clay..........	....	7,500,000
20	Clay (all other than brick)..........short tons..	41,160	300,000
21	Cement..........barrels..	6,503,295	5,021,139
22	Mineral waters..........gallons sold..	9,578,648	1,679,302
23	Phosphate rock..........long tons..	448,567	2,018,552
24	Salt..........barrels..	8,055,881	4,374,203
25	Limestone for iron flux..........long tons..	5,438,000	2,719,000
26	Zinc white..........short tons..	20,000	1,600,000
27	Gypsum..........do....	110,000	550,000
28	Borax..........pounds..	7,589,000	455,340
29	Mineral paints..........short tons..	26,500	405,000
30	Grindstones..........	....	281,800
31	Fibrous talc..........short tons..	20,000	210,000
32	Asphalt..........do....	53,800	331,500
33	Soapstone..........do....	15,000	250,000
34	Precious stones..........	....	139,850
35	Pyrite..........long tons..	54,331	167,658
36	Corundum..........short tons..	589	91,620
37	Oilstones, etc.[a]..........pounds..	1,500,000	18,000
38	Mica..........do....	48,000	70,000
39	Barytes (crude)..........short tons..	20,000	110,000
40	Bromine..........pounds..	307,386	95,290
41	Fluorspar..........short tons..	6,000	30,000
42	Feldspar..........long tons..	8,700	50,000
43	Manganese ores..........do....	29,198	279,571
44	Flint..........do....	30,000	127,500
45	Graphite..........pounds..	400,000	33,000
46	Bauxite..........long tons..	....	....
47	Sulphur..........short tons..	....	....
48	Marls..........do....	300,000	150,000
49	Infusorial earth..........do....	1,500	7,500
50	Millstones..........	....	81,000
51	Chromic iron ore..........long tons..	1,500	20,000
52	Cobalt oxide..........pounds..	8,491	15,782
53	Magnesite..........short tons..	....	....
54	Asbestos..........do....	100	3,000
55	Rutile..........pounds..	1,000	3,000
56	Ozocerite (refined)..........do....	43,500	3,000
57	Total value of nonmetallic mineral products..........	....	286,150,114
58	Total value of metallic products..........	....	237,574,422
59	Estimated value of mineral products unspecified..........	....	900,000
60	Grand total..........	....	524,624,536

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[a] Prior to 1889 quantity and value are for rough stone quarried; since 1890 they are for finished product.

the calendar years 1880–1907—Continued.

1889.		1890.		1891.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
7,603,642	$120,000,000	9,202,703	$151,200,410	8,279,870	$128,387,985	1
50,094,500	46,838,400	54,516,300	57,242,100	58,330,000	57,630,000	2
1,594,775	32,967,000	1,588,877	32,845,000	1,604,840	33,175,000	3
231,246,214	26,907,809	265,115,133	30,848,797	295,812,076	38,455,300	4
156,397	13,794,235	143,630	12,668,166	178,554	15,534,198	5
58,860	5,791,824	63,683	6,266,407	80,873	8,033,700	6
26,484	1,190,500	22,926	1,203,615	22,904	1,036,386	7
47,468	97,335	61,281	61,281	150,000	100,000	8
115	28,000	938	177,508	1,289	217,957	9
252,663	151,598	223,488	134,093	118,498	71,099	10
....	....	....	....	125,289	25,058	11
500	2,000	600	2,500	100	500	12
....	247,768,701	....	292,649,877	....	282,617,183	13
95,685,543	94,504,745	111,320,016	110,420,801	117,901,237	117,188,400	14
40,714,721	65,879,514	41,489,858	66,383,772	45,236,992	73,944,735	15
....	42,809,706	....	47,000,000	....	47,294,746	16
35,163,513	26,963,340	45,822,672	35,365,105	54,291,980	30,526,553	17
....	21,097,099	....	18,792,725	....	15,500,084	18
....	8,000,000	....	8,500,000	....	9,000,000	19
329,665	635,578	392,000	756,000	448,000	900,000	20
7,000,000	5,000,000	8,000,000	6,000,000	8,222,792	6,680,951	21
12,780,471	1,748,458	13,907,418	2,600,750	18,392,732	2,996,259	22
550,245	2,937,776	510,499	3,213,795	587,988	3,651,150	23
8,005,565	4,195,412	8,776,991	4,752,286	9,987,945	4,716,121	24
6,318,000	3,159,000	5,521,622	2,760,811	5,000,000	2,300,000	25
16,970	1,357,600	....	1,600,000	23,700	1,600,000	26
267,769	764,118	182,995	574,523	208,126	628,051	27
8,000,000	500,000	9,500,000	617,500	13,380,000	869,700	28
34,307	483,766	47,732	681,992	49,652	678,478	29
....	439,587	....	450,000	....	476,113	30
23,746	244,170	41,354	389,196	53,054	493,068	31
51,735	171,537	40,841	190,416	45,054	242,264	32
12,715	231,708	13,670	252,309	16,514	243,981	33
....	188,807	....	118,833	....	235,300	34
93,705	202,119	99,854	273,745	106,536	338,880	35
2,245	105,565	1,970	89,395	2,265	90,230	36
5,982,000	32,980	....	69,909	1,375,000	150,000	37
49,500	50,000	60,000	75,000	75,000	100,000	38
19,161	106,313	21,911	86,505	31,069	118,363	39
418,891	125,667	387,847	104,719	343,000	54,880	40
9,500	45,835	8,250	55,328	10,044	78,330	41
6,970	39,370	8,000	45,200	10,000	50,000	42
24,197	240,559	25,684	219,050	23,416	239,129	43
21,113	89,730	13,000	57,400	15,000	60,000	44
....	72,662	....	77,500	....	110,000	45
728	2,366	1,844	6,012	3,593	11,675	46
1,150	7,850	....	....	1,200	39,600	47
139,522	63,956	153,620	69 880	135,000	67,500	48
3,466	23,372	2,532	50,240	....	21,988	49
....	35,155	....	23,720	....	16,587	50
2,000	30,000	3,599	53,985	1,372	20,580	51
13,955	31,092	6,788	16,291	7,200	18,000	52
....	....	....	....	439	4,390	53
30	1,800	71	4,560	66	3,390	54
1,000	3,000	400	1,000	300	800	55
50,000	2,500	350,000	26,250	50,000	7,000	56
....	282,623,812	....	312,826,503	....	321,767,846	57
....	247,768,701	....	292,649,877	....	282,617,183	58
....	1,000,000	....	1,000,000	....	1,000,000	59
....	531,392,513	....	606,476,380	....	605,385,029	60

Mineral products of the United States for

	Product.	1892.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron, spot value..........long tons..	9,157,000	$131,161,039
2	Silver, commercial value..........troy ounces..	63,500,000	55,662,500
3	Gold, coining value..........do....	1,597,098	33,015,000
4	Copper, value at New York City..........pounds..	352,971,744	37,977,142
5	Lead, value at New York City..........short tons..	173,654	13,892,320
6	Zinc, value at New York City..........do....	87,260	8,027,920
7	Quicksilver, value at San Francisco..........flasks..	27,993	1,245,689
8	Aluminum, value at Pittsburg..........pounds..	259,885	172,824
9	Antimony, value at San Francisco..........short tons..	1,790	276,416
10	Nickel, value at Philadelphia..........pounds..	92,252	50,739
11	Tin..........do....	162,000	32,400
12	Platinum, value (crude) at San Francisco..........troy ounces..	80	550
13	Total value of metallic products..........	....	281,514,539
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal..........short tons..	126,856,567	125,124,381
15	Pennsylvania anthracite..........long tons..	46,850,450	82,442,000
16	Natural gas..........	....	14,870,714
17	Petroleum..........barrels..	50,509,136	26,034,196
18	Brick clay..........	....	9,000,000
19	Cement..........barrels..	8,758,621	7,152,750
20	Stone..........	....	48,706,625
21	Corundum and emery..........short tons..	1,771	181,300
22	Crystalline quartz..........do....	....	....
23	Garnet for abrasive purposes..........do....	....	....
24	Grindstones..........	....	272,244
25	Infusorial earth and tripoli..........short tons..	....	43,655
26	Millstones..........	....	23,417
27	Oilstones, etc..........	....	146,730
28	Borax..........pounds..	13,500,000	900,000
29	Bromine..........do....	379,480	64,502
30	Fluorspar..........short tons..	12,250	89,000
31	Gypsum..........do....	256,259	695,492
32	Marls..........do....	125,000	65,000
33	Phosphate rock..........long tons..	681,571	3,296,227
34	Pyrite..........do....	109,788	305,191
35	Salt..........barrels..	11,698,890	5,654,915
36	Sulphur..........short tons..	2,688	80,640
37	Barytes (crude)..........do....	32,108	130,025
38	Cobalt oxide..........pounds..	7,869	15,738
39	Mineral paints..........short tons..	51,704	767,766
40	Zinc white..........do....	27,500	2,200,000
41	Asbestos..........do....	104	6,416
42	Asphalt..........do....	87,680	445,375
43	Bauxite..........long tons..	10,518	34,183
44	Chromic iron ore..........do....	1,500	25,000
45	Clay (all other than brick)..........short tons..	470,400	1,000,000
46	Feldspar..........do....	16,800	75,000
47	Fibrous talc..........do....	41,925	472,485
48	Flint..........do....	22,400	80,000
49	Fuller's earth..........do....	....	....
50	Graphite..........pounds..	....	104,000
51	Limestone for iron flux..........long tons..	5,172,114	3,620,480
52	Magnesite..........short tons..	1,004	10,040
53	Manganese ores..........long tons..	13,613	129,586
54	Mica..........pounds..	75,000	100,000
55	Mineral waters..........gallons sold..	21,876,604	4,905,970
56	Monazite..........pounds..	....	....
57	Ozocerite (refined)..........do....	60,000	8,000
58	Precious stones..........	....	312,050
59	Pumice stone..........short tons..	....	....
60	Rutile..........pounds..	100	300
61	Soapstone..........short tons..	23,908	437,449
62	Total value of nonmetallic mineral products..........	....	340,028,842
63	Total value of metallic products..........	....	281,514,539
64	Estimated value of mineral products unspecified..........	....	1,000,000
65	Grand total..........	....	622,543,381

[a] Including copper made from imported pyrites.

the calendar years 1880–1907—Continued.

1893.		1894.		1895.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
7,124,502	$84,810,426	6,657,388	$65,007,247	9,446,308	$105,198,550	1
60,000,000	46,800,000	49,500,000	31,422,100	55,727,000	36,445,500	2
1,739,323	35,955,000	1,910,813	39,500,000	2,254,760	46,610,000	3
339,785,972	32,054,601	364,866,808	33,141,142	[a] 385,913,404	38,012,470	4
163,982	11,839,590	159,331	9,942,254	170,000	11,220,000	5
78,832	6,306,560	75,328	5,288,026	89,686	6,278,020	6
30,164	1,108,527	30,416	934,000	36,104	1,337,131	7
339,629	266,903	550,000	316,250	920,000	464,600	8
1,503	270,540	1,387	249,706	2,013	304,169	9
49,399	22,197	9,616	3,269	10,302	3,091	10
8,938	1,788	....	....	....	....	11
75	517	100	600	150	900	12
....	219,436,649	....	185,804,594	....	245,874,431	13
128,385,231	122,751,618	118,820,405	107,653,501	135,118,193	115,779,771	14
48,185,306	85,687,078	46,358,144	78,488,063	51,785,122	82,019,272	15
....	14,346,250	....	13,954,400	....	13,006,650	16
48,412,666	28,932,326	49,344,516	35,522,095	52,892,276	57,632,296	17
....	9,000,000	....	[b] 64,655,388	....	[b] 65,409,806	18
8,002,467	6,262,841	8,362,245	5,030,081	8,731,401	5,482,254	19
....	33,885,573	....	36,534,788	....	33,319,131	20
1,713	142,325	1,495	95,936	2,102	106,256	21
....	....	6,024	18,054	9,000	27,000	22
....	....	....	....	3,325	95,050	23
....	338,787	....	223,214	....	205,768	24
....	22,582	2,584	11,718	4,954	20,514	25
....	16,645	....	13,887	....	22,542	26
....	135,173	....	136,873	....	155,881	27
8,699,000	652,425	14,680,130	974,445	11,918,000	595,900	28
348,399	104,520	379,444	102,450	517,421	134,343	29
12,400	84,000	7,500	47,500	4,000	24,000	30
253,615	696,615	239,312	761,719	265,503	797,447	31
75,000	40,000	75,000	40,000	60,000	30,000	32
941,368	4,136,070	996,949	3,479,547	1,038,551	3,606,094	33
75,777	256,552	105,940	363,134	99,549	322,845	34
11,816,772	4,054,668	12,967,417	4,739,285	13,669,649	4,423,084	35
1,200	42,000	500	20,000	1,800	42,000	36
28,970	88,506	23,335	86,983	21,529	68,321	37
8,422	10,346	6,763	10,145	14,458	20,675	38
37,724	530,384	41,926	498,093	50,695	621,552	39
24,059	1,804,420	19,987	1,399,090	20,710	1,449,700	40
50	2,500	325	4,463	795	13,525	41
47,779	372,232	60,570	353,400	68,163	348,281	42
9,079	29,507	11,066	35,818	17,069	44,000	43
1,450	21,750	3,680	53,231	1,740	16,795	44
448,000	900,000	....	....	....	....	45
20,578	68,307	19,264	167,000	8,523	30,000	46
35,861	403,436	39,906	435,060	39,240	370,897	47
33,231	63,792	42,560	319,200	13,747	21,038	48
....	....	....	....	6,900	41,400	49
843,103	63,232	918,000	64,010	....	52,582	50
3,958,055	2,374,833	3,698,550	1,849,275	5,247,949	2,623,974	51
704	7,040	1,440	10,240	2,220	17,000	52
7,718	66,614	6,308	53,635	9,547	71,769	53
66,971	88,929	....	52,388	....	55,831	54
23,544,495	4,246,734	21,569,608	3,741,846	21,463,543	4,254,237	55
130,000	7,600	546,855	36,193	1,573,000	137,150	56
....	....	....	....	....	....	57
....	264,041	....	132,250	....	113,621	58
....	....	....	....	....	....	59
....	....	150	450	100	350	60
21,071	255,067	23,144	401,325	21,495	266,495	61
....	323,257,318	....	362,570,173	....	393,897,097	62
....	219,436,649	....	185,804,594	....	245,874,431	63
....	1,000,000	....	1,000,000	....	1,000,000	64
....	543,693,967	....	549,374,767	....	640,771,528	65

[b] Clay products.

Mineral products of the United States for

	Product.	1896.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron, spot value.......long tons..	8,623,127	$90,250,000
2	Silver, commercial value.......troy ounces..	58,834,800	39,654,600
3	Gold, coining value.......do....	2,568,132	53,088,000
4	Copper, value at New York City.......pounds..	460,061,430	49,456,603
5	Lead, value at New York City.......short tons..	188,000	10,528,000
6	Zinc, value at New York City.......do....	81,499	6,519,920
7	Quicksilver, value at San Francisco.......flasks..	30,765	1,075,449
8	Aluminum, value at Pittsburg.......pounds..	1,300,000	520,000
9	Antimony, value at San Francisco.......short tons..	2,478	347,539
10	Nickel, value at Philadelphia.......pounds..	17,170	4,464
11	Tin.......do....	....	....
12	Platinum, value (crude) at New York City.......troy ounces..	163	944
13	Total value of metallic products.......	....	251,445,519
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal.......short tons..	137,640,276	114,891,515
15	Pennsylvania anthracite.......long tons..	48,523,287	81,748,651
16	Natural gas.......	....	13,002,512
17	Petroleum.......barrels..	60,960,361	58,518,709
18	Clay products.......	....	63,110,408
19	Cement.......barrels..	9,513,473	6,473,213
20	Lime.......	....	6,327,900
21	Slate.......	....	2,746,205
22	Stone.......	....	23,965,229
23	Corundum and emery.......short tons..	2,120	113,246
24	Crystalline quartz.......do....	6,000	18,000
25	Garnet for abrasive purposes.......do....	2,686	68,877
26	Grindstones.......	....	326,826
27	Infusorial earth and tripoli.......short tons..	3,846	26,792
28	Millstones.......	....	22,567
29	Oilstones, etc.......	....	127,098
30	Borax.......pounds..	13,508,000	675,400
31	Bromine.......do....	546,580	144,501
32	Fluorspar.......short tons..	6,500	52,000
33	Gypsum.......do....	224,254	573,344
34	Marls.......do....	60,000	30,000
35	Phosphate rock.......long tons..	930,779	2,803,372
36	Pyrite.......do....	115,483	320,163
37	Salt.......barrels..	13,850,726	4,040,839
38	Sulphur.......short tons..	5,260	87,200
39	Barytes (crude).......do....	17,068	46,513
40	Cobalt oxide.......pounds..	10,700	15,301
41	Mineral paints.......short tons..	43,894	459,089
42	Zinc white.......do....	20,000	1,400,000
43	Asbestos.......do....	504	6,100
44	Asphalt.......do....	80,503	577,563
45	Bauxite.......long tons..	18,364	47,338
46	Chromic iron ore.......do....	786	6,667
47	Feldspar.......short tons..	10,203	35,200
48	Fibrous talc.......do....	46,089	399,443
49	Fuller's earth.......do....	9,872	59,360
50	Graphite (crystalline).......pounds..	535,858	48,460
51	Graphite (amorphous).......short tons..	760	
52	Magnesite.......do....	1,500	11,000
53	Manganese ores.......long tons..	10,088	90,727
54	Mica (sheet).......pounds..	49,156	65,441
55	Mica (scrap).......short tons..	222	1,750
56	Mineral waters.......gallons sold..	25,795,312	4,136,192
57	Monazite.......pounds..	30,000	1,500
58	Ozocerite (refined).......do....	....	....
59	Precious stones.......	....	97,850
60	Pumice stone.......short tons..	....	....
61	Quartz (flint).......do....	12,458	24,226
62	Rutile.......pounds..	100	350
63	Soapstone.......short tons..	22,183	354,065
64	Total value of nonmetallic mineral products.......	....	388,098,702
65	Total value of metallic products.......	....	251,445,519
66	Estimated value of mineral products unspecified.......	....	1,000,000
67	Grand total.......	....	640,544,221

the calendar years 1880–1907—Continued.

1897.		1898.		1899.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
9,652,680	$95,122,299	11,773,934	$116,557,000	13,620,703	$245,172,654	1
53,860,000	32,316,000	54,438,000	32,118,400	54,764,500	32,858,700	2
2,774,935	57,363,000	3,118,398	64,463,000	3,437,210	71,053,400	3
494,078,274	54,080,180	526,512,987	61,865,276	568,666,921	101,222,712	4
212,000	14,885,728	222,000	16,650,000	210,500	18,945,000	5
99,980	8,498,300	115,399	10,385,910	129,051	14,840,865	6
26,648	993,445	31,092	1,188,627	30,454	1,452,745	7
4,000,000	1,500,000	5,200,000	1,716,000	6,500,000	1,716,000	8
3,061	442,300	3,238	532,101	2,861	559,189	9
23,707	7,823	11,145	3,956	22,541	8,566	10
						11
150	900	225	1,913	300	1,800	12
	265,209,975		305,482,183		487,831,631	13
147,617,519	119,595,224	166,593,623	132,608,713	193,323,187	167,952,104	14
46,974,714	79,301,954	47,663,076	75,414,537	53,944,647	88,142,130	15
	13,826,422		15,296,813		20,074,873	16
60,475,516	40,874,072	55,364,233	44,193,359	57,070,850	64,603,904	17
	62,359,991		74,487,680		95,797,370	18
10,989,463	8,178,283	12,111,208	9,859,501	15,520,445	12,889,142	19
	6,390,487		6,886,549		6,983,067	20
	3,524,614		3,723,540		3,962,733	21
	26,876,671		28,635,175		35,244,717	22
2,165	106,574	4,064	275,064	4,900	150,600	23
7,500	22,500	8,312	23,990	13,600	39,000	24
2,554	80,853	2,967	86,850	2,765	98,325	25
	368,058		489,769		675,586	26
3,833	22,835	2,733	16,691	4,334	37,032	27
	25,932		25,934		28,115	28
	149,970		180,486		208,283	29
16,000,000	1,080,000	16,000,000	1,120,000	40,714,000	1,139,882	30
487,149	129,094	486,979	126,614	433,004	108,251	31
5,062	37,159	7,675	63,050	15,900	96,650	32
288,982	755,864	291,638	755,280	486,235	1,287,080	33
60,000	30,000	60,000	30,000	60,000	30,000	34
1,039,345	2,673,202	1,308,885	3,453,460	1,515,702	5,084,076	35
143,201	391,541	193,364	593,801	174,734	543,249	36
15,973,202	4,920,020	17,612,634	6,212,554	19,708,614	6,867,467	37
2,275	45,590	1,200	32,960	4,830	107,509	38
26,042	58,295	31,306	108,339	41,894	139,528	39
19,520	31,232	6,247	9,371	10,230	18,512	40
47,308	501,029	48,479	534,345	51,020	517,328	41
25,000	1,750,000	33,000	2,310,000	40,146	3,211,680	42
580	6,450	605	10,300	681	11,740	43
75,945	664,632	76,337	675,649	75,085	553,904	44
20,590	57,652	25,149	75,437	35,280	125,598	45
						46
12,516	43,100	13,440	32,395	24,202	211,545	47
57,009	396,936	54,356	411,430	54,655	438,150	48
17,113	112,272	14,860	106,500	12,381	79,644	49
1,361,706	65,730	2,360,000	75,200	2,900,732	167,106	50
1,070		890		2,324		51
1,143	13,671	1,263	19,075	1,280	18,480	52
11,108	95,505	15,957	129,185	9,935	82,278	53
82,676	80,774	129,520	103,534	108,570	70,587	54
740	14,452	3,999	27,564	1,505	50,878	55
23,255,911	4,599,106	28,853,464	8,051,833	39,562,136	6,948,030	56
44,000	1,980	250,776	13,542	350,000	20,000	57
						58
	130,675		160,920		185,770	59
158		600	13,200	400	10,000	60
13,466	26,227	21,425	42,670	29,852	180,345	61
100	350	140	700	230	1,030	62
21,923	365,629	22,231	287,112	24,765	330,805	63
	380,782,607		417,790,671		525,524,074	64
	265,209,975		305,482,183		487,831,631	65
	1,000,000		1,000,000		1,000,000	66
	646,992,582		724,272,854		1,014,355,705	67

Mineral products of the United States for

	Product.	1900.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron, value at Philadelphia ... long tons	13,789,242	$259,944,000
2	Silver, commercial value ... troy ounces	57,647,000	35,741,100
3	Gold, coining value ... do	3,829,897	79,171,000
4	Copper, value at New York City ... pounds	606,117,166	98,494,039
5	Lead, value at New York City ... short tons	270,824	23,561,688
6	Zinc, value at New York City ... do	123,886	10,654,196
7	Quicksilver, value at San Francisco ... flasks	28,317	1,302,586
8	Aluminum, value at Pittsburg ... pounds	7,150,000	1,920,000
9	Antimony, value at San Francisco ... short tons	4,226	837,896
10	Nickel, value at Philadelphia ... pounds	9,715	3,886
11	Tin ... do		
12	Platinum, value (crude) at New York City ... troy ounces	400	2,500
13	Total value of metallic products		511,632,891
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal ... short tons	212,316,112	220,930,313
15	Pennsylvania anthracite ... long tons	51,221,353	85,757,851
16	Natural gas		23,698,674
17	Petroleum ... barrels	63,620,529	75,989,313
18	Clay products		96,212,345
19	Cement ... barrels	17,231,150	13,283,581
20	Lime		6,797,496
21	Sand-lime brick		
22	Slate		4,240,466
23	Stone		36,970,777
24	Corundum and emery ... short tons	4,305	102,715
25	Crystalline quartz ... do	14,461	40,705
26	Garnet for abrasive purposes ... do	3,185	123,475
27	Grindstones		710,026
28	Infusorial earth and tripoli ... short tons	3,615	24,207
29	Millstones		32,858
30	Oilstones, etc		174,087
31	Arsenious oxide ... pounds		
32	Borax ... short tons	b1,602	170,036
		c24,235	848,215
33	Bromine ... pounds	521,444	140,790
34	Fluorspar ... short tons	18,450	94,500
35	Gypsum ... do	594,462	1,627,203
36	Lithium ... do	520	
37	Marls ... do	60,000	30,000
38	Phosphate rock ... long tons	1,491,216	5,359,248
39	Pyrite ... do	204,615	749,991
40	Sulphur ... short tons	3,525	88,100
41	Salt ... barrels	20,869,342	6,944,603
42	Barytes (crude) ... short tons	67,680	188,089
43	Cobalt oxide ... pounds	6,471	11,648
44	Mineral paints ... short tons	57,426	644,089
45	Zinc white ... do	48,840	3,667,210
46	Asbestos ... do	1,054	16,310
47	Asphalt ... do	54,389	415,958
48	Bauxite ... long tons	23,184	89,676
49	Chromic iron ore ... do	140	1,400
50	Feldspar ... short tons	24,821	180,971
51	Fibrous talc ... do	63,500	499,500
52	Fuller's earth ... do	9,698	67,535
53	Glass sand ... do		
54	Graphite (crystalline) ... pounds	5,507,855	197,579
55	Graphite (amorphous) ... short tons	611	
56	Magnesite ... do	2,252	19,333
57	Manganese ores ... long tons	11,771	100,289
58	Mica (sheet) ... pounds	456,283	92,758
59	Mica (scrap) ... short tons	5,497	55,202
60	Mineral waters ... gallons sold	47,558,784	6,245,172
61	Monazite and zircon ... pounds	908,000	48,805
62	Precious stones		233,170
63	Pumice stone ... short tons		
64	Quartz (flint) ... do	32,495	86,351
65	Rutile ... pounds	300	1,300
66	Talc and soapstone ... short tons	27,943	383,541
67	Tungsten ... do	46	11,040
68	Uranium and vanadium ... do		
69	Total value of nonmetallic mineral products		594,398,501
70	Total value of metallic products		511,632,891
71	Estimated value of mineral products unspecified		1,000,000
72	Grand total		1,107,031,392

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a No metallic tin; about 20 tons of high-grade concentrates shipped to England from South Carolina.

the calendar years 1880–1907—Continued.

1901.		1902.		1903.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
15,878,354	$242,174,000	17,821,307	$372,775,000	18,009,252	$344,350,000	1
55,214,000	33,128,400	55,500,000	29,415,000	54,300,000	29,322,000	2
3,805,500	78,666,700	3,870,000	80,000,000	3,560,000	73,591,700	3
602,072,519	87,300,515	659,508,644	76,568,954	698,044,517	91,506,006	4
270,700	23,280,200	270,000	22,140,000	282,000	23,520,000	5
140,822	11,265,760	156,927	14,625,596	159,219	16,717,995	6
29,727	1,382,305	34,291	1,467,848	35,620	1,544,934	7
7,150,000	2,238,000	7,300,000	2,284,590	7,500,000	2,284,900	8
2,639	539,902	3,561	634,506	3,128	548,433	9
6,700	3,551	5,748	2,701	114,200	45,900	10
....	....	....	....	(a)	....	11
1,408	27,526	94	1,814	110	2,080	12
....	480,006,859	....	599,916,009	....	583,433,948	13
225,828,149	236,422,049	260,216,844	290,858,483	282,749,348	351,687,933	14
60,242,560	112,504,020	36,940,710	76,173,586	66,613,454	152,036,448	15
....	27,066,077	....	30,867,863	....	35,807,860	16
69,389,194	66,417,335	88,766,916	71,178,910	100,461,337	94,694,050	17
....	110,211,587	....	122,169,531	....	131,062,421	18
20,068,737	15,786,789	25,753,504	25,366,380	29,899,140	31,931,341	19
....	8,204,054	....	9,335,618	....	9,255,882	20
....	....	....	....	....	155,040	21
....	4,787,525	....	5,696,051	....	6,256,885	22
....	47,284,183	....	54,798,682	....	57,433,141	23
4,305	146,040	4,251	104,605	2,542	64,102	24
14,050	41,500	15,104	84,335	8,938	76,908	25
4,444	158,100	3,926	132,820	3,950	132,500	26
....	580,703	....	667,431	....	721,446	27
4,020	52,950	5,665	53,244	9,219	76,273	28
....	57,179	....	59,808	....	52,552	29
....	158,300	....	221,762	....	366,857	30
600,000	18,000	2,706,000	81,180	1,222,000	36,691	31
[b]5,344 [c]17,887	697,307 314,811	[b]17,404 [c]2,600	2,447,614 91,000	[c]34,430	661,400	32
552,043	154,572	513,893	128,472	598,500	167,580	33
19,586	113,803	48,018	271,832	42,523	213,617	34
633,791	1,506,641	816,478	2,089,341	1,041,704	3,792,943	35
1,750	43,200	1,245	25,750	1,155	23,425	36
99,880	124,880	12,439	12,741	34,211	22,521	37
1,483,723	5,316,403	1,490,314	4,693,444	1,581,576	5,319,294	38
241,691	1,257,879	207,874	947,089	[d]233,127	1,109,818	39
(d)	(d)	(d)	(d)			40
20,566,661	6,617,449	23,849,231	5,668,636	18,968,089	5,286,988	41
49,070	157,844	61,668	203,154	50,397	152,150	42
13,360	24,048	3,730	6,714	120,000	228,000	43
52,209	636,145	60,191	745,227	56,262	500,922	44
46,500	3,720,000	52,645	4,016,499	62,962	4,801,718	45
747	13,498	1,005	16,200	887	16,760	46
63,134	555,335	105,458	765,048	101,255	1,005,446	47
18,905	79,914	27,322	120,366	48,087	171,306	48
368	5,790	315	4,567	150	2,250	49
34,741	220,422	45,287	250,424	41,891	256,733	50
69,200	483,600	71,100	615,350	60,230	421,600	51
14,112	96,835	11,492	98,144	20,693	190,277	52
....	....	943,135	807,797	823,044	855,828	53
3,967,612	167,714	3,936,824	182,108	4,538,155	225,554	54
809		4,739		16,591		55
3,500	10,500	2,830	8,490	3,744	10,595	56
11,995	116,722	7,477	60,911	2,825	25,335	57
360,060	98,859	373,266	83,843	619,600	118,088	58
2,171	19,719	1,400	35,006	1,659	25,040	59
55,771,188	7,586,962	64,859,451	8,793,761	51,242,757	9,041,078	60
748,736	59,262	802,000	64,160	865,000	65,200	61
....	289,050	....	328,450	....	307,900	62
....	....	700	2,750	885	2,665	63
34,420	149,297	36,365	144,209	55,233	156,947	64
44,250	5,710	(e)	....	....	....	65
28,643	424,888	26,854	525,157	26,671	418,460	66
179	27,720	184	34,040	292	43,639	67
375	....	3,810	48,125	30	5,625	68
....	660,993,170	....	722,186,708	....	907,495,032	69
....	480,006,859	....	599,916,009	....	583,433,948	70
....	1,000,000	....	1,000,000	....	1,000,000	71
....	1,142,000,029	....	1,323,102,717	....	1,491,928,980	72

[b] Refined. [c] Crude. [d] Included under pyrite. [e] Included under estimated unspecified products.

Mineral products of the United States for the calendar years 1880–1907—Continued.

Product.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
METALLIC.				
Pig iron (spot value)....long tons..	16,497,033	$233,025,000	22,992,380	$382,450,000
Silver, commercial value....troy ounces..	57,682,800	33,456,000	56,101,600	34,221,976
Gold, coining value....do....	3,892,480	80,464,700	4,265,742	88,180,700
Copper, value at New York City....pounds..	812,537,267	105,629,845	901,907,843	139,795,716
Lead, value at New York City....short tons..	307,000	26,402,000	302,000	28,690,000
Zinc, value at New York City....do....	186,702	18,670,200	203,849	24,054,182
Quicksilver, value at San Francisco....flasks..	34,570	1,503,795	30,451	1,103,120
Aluminum, value at Pittsburg....pounds..	8,600,000	2,477,000	11,347,000	3,246,300
Antimony, value, San Francisco...short tons..	3,057	505,524	3,240	705,787
Nickel, value at Philadelphia....pounds..	24,000	11,400		
Tin....do....			None.	
Platinum, value (crude) at New York City, troy ounces....	200	4,160	318	5,320
Total value of metallic products....		502,149,624		702,453,101
NONMETALLIC (spot values).				
Bituminous coal....short tons..	278,659,689	305,397,001	315,062,785	334,658,294
Pennsylvania anthracite....long tons..	65,318,490	138,974,020	69,339,152	141,879,000
Natural gas....		38,496,760		41,562,855
Petroleum....barrels..	117,080,960	101,175,455	134,717,580	84,157,399
Clay products....		131,023,248		149,697,188
Cement....barrels..	31,675,257	26,031,920	40,102,308	35,931,533
Lime....short tons..	2,707,809	9,951,456	2,984,100	10,941,680
Sand-lime brick....		463,128		972,064
Slate....		5,617,195		5,496,207
Stone....		58,765,715		63,798,748
Corundum and emery....short tons..	1,916	56,985	2,126	61,464
Crystalline quartz....do....	31,940	74,850	19,039	88,118
Garnet for abrasive purposes....do....	3,854	117,581	5,050	148,095
Grindstones....		881,527		777,606
Infusorial earth and tripoli....short tons..	6,274	44,164	10,977	64,637
Millstones....		37,338		37,974
Oilstones, etc....		188,985		244,546
Arsenious oxide....pounds..	72,413	2,185	1,507,386	35,210
Borax (crude)....short tons..	45,647	698,810	46,334	1,019,154
Bromine....pounds..	897,100	269,130	1,192,758	178,914
Fluorspar....short tons..	36,452	234,755	57,385	362,488
Gypsum....do....	940,917	2,784,325	1,043,202	3,029,227
Lithium minerals....do....	577	5,155	79	1,412
Marls....do....	18,989	13,145	38,026	16,494
Phosphate rock....long tons..	1,874,428	6,580,875	1,947,190	6,763,403
Pyrite....do....	334,373	3,478,568	253,000	938,492
Sulphur....do....			181,677	3,706,560
Salt....barrels..	22,030,002	6,021,222	25,966,122	6,095,922
Barytes (crude)....short tons..	65,727	174,958	48,235	148,803
Cobalt oxide....pounds..	22,000	42,600		
Mineral paints....short tons..	64,592	1,448,551	70,355	1,932,048
Zinc white....do....	63,363	4,808,482	68,603	5,520,240
Asbestos....do....	1,480	25,740	3,109	42,975
Asphalt....do....	108,572	879,836	115,267	758,153
Bauxite....long tons..	47,661	235,704	48,129	240,292
Chromic iron ore....do....	123	1,845	22	375
Feldspar....short tons..	45,188	266,326	35,419	226,157
Fibrous talc....do....	64,005	507,400	56,500	445,000
Fuller's earth....do....	29,480	168,500	25,178	214,497
Glass sand....do....	858,719	796,492	1,060,334	1,107,730
Graphite (crystalline)....pounds..	5,681,177	321,372	6,036,567	318,211
Graphite (amorphous)....short tons..	16,927		21,953	
Magnesite....do....	2,850	9,298	3,933	15,221
Manganese ores....long tons..	3,146	29,466	4,118	36,214
Mica (sheet)....pounds..	668,358	109,462	924,875	160,732
Mica (scrap)....short tons..	1,096	10,854	1,126	17,856
Mineral waters....gallons sold..	50,723,500	7,198,450	47,590,081	6,811,611
Monazite and zircon....pounds..	745,999	85,038	1,352,418	163,908
Precious stones....		324,300		326,350
Pumice stone....short tons..	1,530	5,421	1,832	5,540
Quartz (flint)....do....	52,270	100,590	51,145	104,109
Rutile....pounds..		7,000		
Sand, molding, etc., and gravel...short tons..	9,821,009	4,951,607	22,144,633	10,115,915
Talc and soapstone....do....	27,184	433,331	40,134	637,062
Tungsten....do....	740	184,000	803	268,676
Uranium and vanadium....do....	45	10,600	4	375
Total value of nonmetallic mineral products....		860,522,721		2,282,734
Total value of metallic products....		502,149,624		702,453,101
Estimated value of mineral products unspecified....		400,000		400,000
Grand total....		1,363,072,345		1,625,135,835

Mineral products of the United States for the calendar years 1880–1907—Continued.

Product.	1906.		1907.	
	Quantity.	Value.	Quantity.	Value.
METALLIC.				
Pig iron (spot value)....long tons	25,307,191	$505,700,000	25,781,361	$529,958,000
Silver, commercial value....troy ounces	56,517,900	38,256,400	56,514,700	37,299,700
Gold, coining value....do	4,565,333	94,373,800	4,374,827	90,435,700
Copper, value at New York City....pounds	917,805,682	177,595,888	868,996,491	173,799,300
Lead, value at New York City....short tons	350,153	39,917,442	365,166	38,707,596
Zinc, value at New York City....do	199,694	24,362,668	223,745	26,401,910
Quicksilver, value at San Francisco....flasks	26,238	958,634	21,567	828,931
Aluminum, value at Pittsburg....pounds	14,910,000	4,262,286	17,211,039	4,926,948
Antimony, value at San Francisco, short tons	1,766	602,949	2,022	622,046
Nickel, value at Philadelphia....pounds		(a)		(a)
Tin....do		35,600		33,285
Platinum, value (crude) at New York City, troy ounces	1,439	45,189	357	10,589
Total value of metallic products		886,110,856		903,024,005
NONMETALLIC (spot values).				
Bituminous coal....short tons	342,874,867	381,162,115	394,759,112	451,214,842
Pennsylvania anthracite....long tons	63,645,010	131,917,694	76,432,421	163,584,056
Natural gas		46,873,932		52,866,835
Petroleum....barrels	126,493,936	92,444,735	166,095,335	120,106,749
Clay products		161,032,722		158,942,369
Cement....barrels	51,000,445	55,302,277	52,230,342	55,903,851
Lime....short tons	3,198,087	12,480,653	3,084,799	12,640,512
Sand-lime brick		1,170,005		1,225,769
Slate		5,668,346		6,019,220
Stone		66,378,794		71,105,805
Corundum and emery....short tons	1,160	44,310	1,069	12,294
Abrasive quartz and feldspar....do	24,082	121,671	17,435	126,582
Garnet for abrasive purposes....do	4,650	157,000	7,058	211,686
Grindstones		744,894		896,022
Infusorial earth and tripoli....short tons	8,099	72,108		104,406
Millstones		48,590		31,741
Oilstones, etc		268,070		264,188
Arsenious oxide....pounds	1,474,000	63,460	3,502,000	163,000
Borax (crude)....short tons	58,173	1,182,410	52,850	1,121,520
Bromine....pounds	1,283,250	165,204	1,379,496	195,281
Fluorspar....short tons	40,796	244,025	49,486	287,282
Gypsum....do	1,540,585	3,837,975	1,751,748	4,942,264
Lithium minerals....do	383	7,411	530	11,000
Marls....do	19,104	7,341	14,091	8,429
Phosphate rock....long tons	2,080,957	8,579,437	2,265,343	10,653,558
Pyrite....do	261,422	931,305	247,387	794,949
Sulphur....do	294,153	5,096,678	293,106	5,142,850
Salt....barrels	28,172,380	6,658,350	29,704,128	7,439,551
Barytes (crude)....short tons	50,231	160,367	89,621	291,777
Cobalt oxide....pounds		(a)		(a)
Mineral paints....short tons	66,033	2,161,461	71,973	2,979,158
Zinc white....do	74,680	5,999,375	71,784	6,490,660
Asbestos....do	1,695	28,565	653	11,899
Asphaltum....do	138,059	1,290,340	223,861	2,826,489
Bauxite....long tons	75,332	368,311	97,776	480,330
Chromic iron ore....do	107	1,800	290	5,640
Feldspar....short tons	75,656	401,531	84,544	499,069
Fibrous talc....do	61,672	557,200	67,800	626,000
Fuller's earth....do	32,040	265,400	32,851	291,773
Glass sand....do	1,089,430	1,208,788	1,187,296	1,250,067
Graphite, crystalline....pounds	5,887,982	238,064	4,947,840	171,149
Graphite, amorphous....short tons	16,853	102,175	26,803	125,821
Magnesite....do	7,805	23,415	7,561	22,683
Manganese ores....long tons	6,921	88,132	5,604	63,369
Manganiferous ores....do	41,300	122,400	103,844	259,473
Mica, sheet....pounds	1,423,100	252,248	1,060,182	349,311
Mica, scrap....short tons	1,489	22,742	3,025	42,800
Mineral waters....gallons sold	48,103,580	8,028,387	52,060,520	7,331,503
Monazite and zircon....pounds	847,275	152,560	548,152	65,800
Precious stones		[b]589,000		[b]735,800
Pumice stone....short tons	12,200	16,750	8,112	33,818
Quartz....do	66,697	243,012	22,977	157,094
Rutile....pounds				(a)
Sand, molding, etc., and gravel....short tons	31,842,572	11,489,420	40,664,622	13,242,002
Talc and soapstone....do	58,972	874,356	72,010	905,047
Tungsten....do	928	348,867	1,640	890,048
Uranium and vanadium....do		(a)		(a)
Total value of nonmetallic mineral products		1,017,696,178		1,166,165,191
Total value of metallic products		886,110,856		903,024,005
Estimated value of mineral products unspecified		200,000		100,000
Grand total		1,904,007,034		2,069,289,196

[a] Included under unspecified.

[b] Includes pearls valued at $381,000 in 1906, and $264,500 in 1907.

OUTPUT AND VALUE, BY STATES AND TERRITORIES, OF THE MINERAL PRODUCTS OF THE UNITED STATES IN THE CALENDAR YEAR 1907.

In the following table are shown the quantity and the value, by States and Territories, of the mineral products of the United States in 1907.

The values for gold and silver are the official figures agreed upon by the United States Geological Survey and the Director of the Mint. The figures for the tonnage (not the value) of pig iron in 1907 are taken from the annual report prepared by Mr. James M. Swank, general manager of the American and Steel Association.[a]

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907.

ALABAMA.

Product.	Quantity.	Value.
Clay products		$1,754,409
Coal ... short tons	14,250,454	18,405,468
Copper ... pounds		(b)
Gold ... fine ounces (troy)	1,325	27,400
Graphite ... short tons	715	54,000
Iron, pig ... long tons	1,686,674	30,100,000
Lime ... short tons	85,909	368,902
Mineral waters ... gallons sold	130,800	20,720
Natural gas		(c)
Sand and gravel ... short tons	311,659	169,872
Silver ... fine ounces (troy)	600	400
Stone		828,847
Other products		[d]406,740
Total		52,136,749

ALASKA.

Coal ... short tons		(e)
Copper ... pounds	7,034,763	$1,406,953
Gold ... fine ounces (troy)	894,424	18,489,400
Silver ... do	179,300	118,300
Stone		38,110
Other products		[f]147,789
Total		20,200,552

ARIZONA.

Clay products		$101,462
Copper ... pounds	256,778,437	51,355,687
Gold ... fine ounces (troy)	128,871	2,664,000
Lead ... short tons	2,340	248,040
Lime ... do	12,825	84,262
Precious stones		21,280
Silver ... fine ounces (troy)	2,903,100	1,916,000
Stone		237,110
Tungsten		10,769
Zinc ... do	77	9,086
Other products		[g]105,994
Total		56,753,650

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[a] Ann. Statist. Rept. Am. Iron and Steel Association for the year 1907.

[b] Included under Miscellaneous.

[c] Included under Texas.

[d] Includes in 1907: Bauxite, mica, Portland and puzzolan cement, pyrite, sand-lime brick.

[e] Included under California.

[f] Includes in 1907: Graphite, gypsum, tin, mineral waters.

[g] Includes in 1907; Asbestos, Portland cement, mineral waters, sand and gravel, sand-lime brick.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

ARKANSAS.

Product.		Quantity.	Value.
Clay products			$536,286
Coal	short tons	2,670,438	4,473,693
Glass sand	do	43	32
Lead	do	15	1,590
Lime	do	33,472	159,566
Manganiferous ores	long tons	4,133	8,266
Mineral waters	gallons sold	431,511	85,236
Natural gas			(a)
Precious stones			2,800
Sand and gravel	short tons	165,070	81,645
Slate			8,500
Stone			315,478
Zinc	short tons	1,911	225,498
Other products			[b] 488,157
Total			6,386,747

CALIFORNIA.

Product.		Quantity.	Value.
Asphalt	short tons	131,068	$1,213,957
Borax	do	52,850	1,121,520
Cement, Portland	barrels	(c)	(c)
Chromite	long tons	290	5,640
Clay products			5,740,537
Coal	short tons	[d] 24,089	91,813
Copper	pounds	33,696,602	6,739,320
Glass sand	short tons	11,064	8,179
Gold	fine ounces (troy)	815,288	16,853,500
Gypsum			141,675
Lead	short tons	854	90,524
Lime	do	84,981	691,851
Magnesite	do	7,561	22,683
Manganese ores	long tons	100	600
Mineral waters	gallons sold	1,680,169	460,972
Natural gas			168,397
Ocher	short tons	450	3,970
Petroleum	barrels	39,748,375	14,699,956
Platinum	crude ounces (troy)	300	8,898
Precious stones			173,715
Pyrite	long tons	51,950	174,549
Quicksilver	flasks	17,431	662,544
Salt	barrels	626,693	302,940
Sand and gravel	short tons	1,233,869	170,687
Sand-lime brick			63,150
Silver	fine ounces (troy)	1,590,000	1,049,400
Slate			60,000
Stone			3,134,429
Zinc	short tons	140	16,520
Other products			[c] 2,817,510
Total			56,679,436

COLORADO.

Product.		Quantity.	Value.
Clay products			$2,041,475
Coal	short tons	10,790,236	15,079,449
Copper	pounds	13,998,496	2,799,699
Fluorspar	short tons	3,300	11,400
Glass sand	do	2,000	2,500
Gold	fine ounces (troy)	1,010,921	20,897,600
Iron, pig	long tons		(e)
Lead	short tons	48,876	5,180,856
Lime	do	5,679	28,798

[a] Included under Miscellaneous.

[b] Includes in 1907: Bauxite, fuller's earth, oilstones, phosphate rock, sand-lime brick.

[c] Includes in 1907: Asbestos, Portland cement, infusorial earth, metallic paint, quartz, talc and soapstone, and tungsten.

[d] Includes Alaska.

[e] Includes in 1907: Portland cement, fuller's earth, gypsum, graphite, mica, pig iron, sand-lime brick, sulphur, uranium, and zinc lead.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

COLORADO—Continued.

Product.		Quantity.	Value.
Manganiferous ores	long tons	99,711	$251,207
Mineral waters	gallons sold	775,100	154,415
Natural gas			(a)
Petroleum	barrels	331,851	272,813
Precious stones			10,790
Sand and gravel	short tons	66,456	22,573
Silver	fine ounces (troy)	11,495,400	7,587,000
Stone			869,328
Tungsten			573,643
Vanadium			6,000
Zinc	short tons	26,077	3,077,086
Other products			b 12,237,596
Total			71,105,128

CONNECTICUT.

Lime	short tons	81,433	$358,052
Mineral waters	gallons sold	307,906	41,439
Precious stones			133
Sand and gravel	short tons	29,815	26,193
Stone			1,052,582
Other products			c 1,911,120
Total			3,389,519

DELAWARE.

Clay products			$190,440
Sand and gravel	short tons	147,282	63,887
Stone			158,192
Other products			d 18,919
Total			431,438

DISTRICT OF COLUMBIA.

Clay products			$322,084
Other products			15,210
Total			337,294

FLORIDA.

Clay products			$354,575
Fuller's earth	short tons	22,960	213,620
Mineral waters	gallons sold	43,430	12,378
Phosphate rock	long tons	1,357,365	6,577,757
Sand and gravel	short tons	15,798	6,609
Sand-lime brick			109,275
Stone			15,000
Other products			76,540
Total			7,365,754

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[a] Included under Miscellaneous.

[b] Includes in 1907: Portland cement, fuller's earth, gypsum, graphite, mica, pig iron, sand-lime brick, sulphur, uranium, and zinc lead.

[c] Includes in 1907: Clay products, infusorial earth, pig iron, abrasive quartz and feldspar, metallic paint, quartz, precious stones.

[d] Includes in 1907: Mineral waters, sand-lime brick.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

GEORGIA.

Product.	Quantity.	Value.
Clay products		$2,490,237
Coal ... short tons	[a]362,401	499,686
Copper ... pounds		([b])
Glass sand ... short tons	4,800	4,800
Gold ... fine ounces (troy)	3,135	64,800
Lead ... short tons	2	212
Lime ... do	18,349	70,826
Mineral waters ... gallons sold	246,800	28,120
Ocher ... short tons	5,600	57,100
Sand and gravel ... do	226,290	81,991
Sand-lime brick		89,582
Silver ... fine ounces (troy)	700	500
Stone		1,745,638
Talc and soapstone ... short tons	739	11,473
Other products		[c]1,496,038
Total		6,641,003

IDAHO.

Coal ... short tons	[d]7,588	$31,119
Copper ... pounds	9,707,299	1,941,460
Gold ... fine ounces (troy)	60,754	1,255,900
Lead ... short tons	112,569	11,932,314
Lime ... do	5,964	49,022
Salt ... barrels	1,600	2,040
Silver ... fine ounces (troy)	7,888,400	5,206,300
Stone		65,843
Zinc ... short tons	3,508	413,944
Other products		[e]402,670
Total		21,300,612

ILLINOIS.

Cement, natural ... barrels	284,599	$92,750
Portland ... do	2,036,093	2,632,576
Clay products		13,220,489
Coal ... short tons	51,317,146	54,687,382
Fluorspar ... do	25,128	141,971
Glass sand ... do	235,716	152,619
Iron, pig ... long tons	2,457,768	52,229,000
Lead ... short tons	498	52,788
Lime ... do	124,784	559,305
Mineral waters ... gallons sold	720,400	91,760
Natural gas		143,577
Petroleum ... barrels	24,281,973	16,432,947
Sand and gravel ... short tons	4,315,275	1,215,034
Silver ... fine ounces (troy)	2,900	1,900
Stone		3,789,342
Zinc ... short tons	1,446	170,628
Other products		[f]154,396
Total		145,768,464

INDIANA.

Cement, natural ... barrels	400,000	$140,000
Portland ... do	3,782,841	4,757,860
Clay products		6,858,124
Coal ... short tons	13,985,713	15,114,300
Glass sand ... do	30,500	23,000
Lime ... do	107,964	335,151
Mineral waters ... gallons sold	514,366	507,746

[a] Includes North Carolina.

[b] Under Miscellaneous.

[c] Includes in 1907: Asbestos, barytes, bauxite, natural and Portland cement, fuller's earth, graphite, mica, pig iron, pyrite, precious stones, tungsten.

[d] Includes Nebraska and Nevada.

[e] Includes in 1907: Antimony, clay products, mica, mineral waters, phosphate rock, sand-lime brick.

[f] Includes in 1907: Puzzolan cement, infusorial earth, metallic paint, pyrite, quartz, sienna, umber, sand-lime brick.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

INDIANA—Continued.

Product.	Quantity.	Value.
Natural gas		$1,572,605
Oilstones		21,692
Petroleum barrels	5,128,037	4,536,930
Sand and gravel short tons	5,588,392	784,718
Sand-lime brick		95,527
Stone		3,639,551
Other products		[a] 754,013
Total		39,141,217

IOWA.

Product.	Quantity.	Value.
Clay products		$3,728,785
Coal short tons	7,574,322	12,258,012
Gypsum do		730,383
Lead do	225	23,850
Lime do	19,944	84,011
Mineral waters gallons sold	127,200	30,500
Sand and gravel short tons	461,784	110,501
Sand-lime brick		55,618
Stone		564,124
Zinc short tons	220	25,960
Other products		11,350
Total		17,623,094

KANSAS.

Product.	Quantity.	Value.
Cement, Portland barrels	3,353,925	$4,240,358
Clay products		2,370,058
Coal short tons	7,322,449	11,159,698
Gypsum do		414,266
Lead do	1,798	190,588
Lime do	4,124	18,131
Mineral waters gallons sold	362,252	61,454
Natural gas		4,843,019
Petroleum barrels	2,409,521	965,134
Salt do	2,667,459	962,334
Sand and gravel short tons	556,625	117,313
Stone		860,579
Zinc short tons	13,850	1,634,300
Other products		[b] 739,812
Total		28,577,044

KENTUCKY.

Product.	Quantity.	Value.
Asphalt short tons	13,387	$92,465
Clay products		2,611,364
Coal short tons	10,753,124	11,405,038
Fluorspar do	21,058	133,911
Glass sand do	7,400	4,592
Lead do	75	7,950
Lime do	4,670	14,945
Mineral waters gallons sold	736,920	72,373
Natural gas		380,176
Petroleum barrels	[c] 820,844	862,396
Sand and gravel short tons	429,392	259,358
Stone		1,002,450
Zinc short tons	358	42,244
Other products		[d] 2,405,079
Total		19,294,341

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[a] Includes in 1907: Pig iron, pyrite.

[b] Includes in 1907: Natural cement, sand-lime brick, zinc lead, zinc oxide.

[c] Includes Tennessee.

[d] Includes in 1907: Barytes, natural, Portland, and puzzolan cement, infusorial earth, pig iron, ocher, sand-lime brick.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

LOUISIANA.

Product.	Quantity.	Value.
Clay products		$928,570
Natural gas		(*a*)
Petroleum barrels	5,000,221	4,063,033
Salt do	1,157,621	226,892
Sand and gravel short tons	1,233,750	442,924
Other products		*b* 5,215,300
Total		10,876,719

MAINE.

Clay products		$658,913
Lime short tons	159,494	747,947
Mineral waters gallons sold	1,161,832	414,300
Precious stones		1,100
Slate		236,606
Stone		2,147,770
Zinc short ton	1	118
Other products		*c* 172,319
Total		4,379,073

MARYLAND.

Clay products		$1,886,362
Coal short tons	5,532,628	6,623,697
Copper pounds		(*d*)
Glass sand short tons	13,370	13,215
Lime do	103,423	324,316
Mineral waters gallons sold	1,023,562	110,039
Sand and gravel short tons	574,389	254,833
Slate		116,060
Stone		1,439,355
Talc and soapstone short tons	5,067	32,260
Other products		*e* 8,555,121
Total		19,356,250

MASSACHUSETTS.

Clay products		$2,128,820
Glass sand short tons	7,500	37,734
Lime do	119,072	596,778
Mineral waters gallons sold	4,661,115	208,579
Precious stones		100
Sand and gravel short tons	193,259	103,543
Stone		3,218,979
Other products		*f* 289,648
Total		6,584,181

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[a] Included under Texas.

[b] Includes in 1907: Mineral waters, sulphur.

[c] Includes in 1907: Feldspar, mica, sand and gravel.

[d] Under Miscellaneous.

[e] Includes in 1907: Natural cement, infusorial earth, feldspar, pig iron, sand-lime brick, abrasive quartz, quartz, metallic paint and mortar colors.

[f] Includes in 1907: Bromine, abrasive quartz, emery, feldspar, fuller's earth, infusorial earth, pig iron, pyrite, quartz, salt, talc.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

MICHIGAN.

Product.	Quantity.	Value.
Cement, Portland...barrels	3,572,668	$4,384,731
Clay products		1,847,764
Coal...short tons	2,035,858	3,660,833
Copper...pounds	219,131,503	43,826,301
Glass sand...short tons	4,300	8,600
Gypsum		681,351
Lime...short tons	65,822	276,534
Mineral waters...gallons sold	1,472,679	127,133
Salt...barrels	10,786,630	2,062,357
Sand and gravel...short tons	1,020,341	280,995
Sand-lime brick		172,840
Silver...fine ounces (troy)	331,300	218,700
Stone		813,336
Other products		[a] 11,712,445
Total		70,073,920

MINNESOTA.

Product.	Quantity.	Value.
Clay products		$1,689,933
Lime...short tons	20,450	88,900
Mineral waters...gallons sold	9,654,030	524,800
Sand and gravel...short tons	417,692	130,350
Stone		1,582,126
Other products		[b] 1,441,313
Total		5,457,422

MISSISSIPPI.

Product.	Quantity.	Value.
Clay products		$846,529
Mineral waters...gallons sold	425,500	93,350
Sand and gravel...short tons	169,415	75,863
Other products		8,560
Total		1,024,302

MISSOURI.

Product.	Quantity.	Value.
Barytes...short tons	44,039	$162,459
Clay products		6,898,871
Coal...short tons	3,997,936	6,540,709
Copper...pounds		(c)
Glass sand...short tons	138,483	92,898
Lead...do	122,856	13,022,736
Lime...do	190,300	877,970
Mineral waters...gallons sold	667,232	103,314
Natural gas		17,010
Sand and gravel...short tons	2,936,797	698,076
Silver...fine ounces (troy)	25,300	16,700
Stone		2,325,611
Sublimed blue Sublimed white lead...short tons	9,911	1,162,232
Zinc...do	141,824	16,735,232
Other products		[d] 4,475,613
Total		53,129,431

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[a] Includes in 1907: Bromine, graphite, grindstones, oilstones, petroleum, pig iron.

[b] Includes in 1907: Natural cement, abrasive feldspar, feldspar, pig iron, sand-lime brick.

[c] Under Miscellaneous.

[d] Includes in 1907: Portland cement, grindstones, cobalt oxide, petroleum, pig iron, tripoli, zinc lead.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

MONTANA.

Product.	Quantity.	Value.
Clay products		$272,872
Coal ... short tons	2,016,857	3,907,082
Copper ... pounds	224,263,789	44,852,758
Gold ... fine ounces (troy)	167,987	3,472,600
Lead ... short tons	2,035	215,710
Lime ... do	4,217	25,340
Precious stones		229,800
Silver ... fine ounces (troy)	11,129,600	7,345,500
Stone		265,956
Tungsten		32,700
Other products		[a] 43,193
Total		60,663,511

NEBRASKA.

Clay products		$953,432
Coal		(b)
Sand and gravel ... short tons	374,590	54,227
Stone		324,239
Other products		[c] 52,018
Total		1,383,916

NEVADA.

Coal		(d)
Copper ... pounds	1,998,164	$399,633
Gold ... fine ounces (troy)	745,507	15,411,000
Lead ... short tons	3,380	358,280
Precious stones		5,525
Salt ... barrels	6,457	3,654
Silver ... fine ounces (troy)	8,280,500	5,465,100
Zinc ... short tons	1,692	199,656
Other products		[e] 245,852
Total		22,088,700

NEW HAMPSHIRE.

Clay products		$510,599
Mica		7,227
Mineral waters ... gallons sold	343,500	164,943
Stone		647,721
Other products		[f] 59,870
Total		1,390,360

NEW JERSEY.

Cement, Portland ... barrels	4,449,896	$4,738,516
Clay products		16,005,460
Glass sand ... short tons	87,140	73,914
Iron, pig ... long tons	373,189	7,554,000
Lime ... short tons	34,043	167,149
Marls ... do	14,091	8,429
Mineral waters ... gallons sold	982,445	103,082
Sand and gravel ... short tons	2,124,696	971,345
Sand-lime brick		22,792
Slate		8,000
Stone		1,523,312
Zinc ... short tons	13,573	1,601,614
Other products		[g] 22,686
Total		32,800,299

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[a] Includes in 1907: Arsenic, grindstones, mineral waters, sand and gravel.

[b] Included under Idaho.

[c] Includes in 1907: Mineral waters, pumice, sand-lime brick.

[d] Included under Idaho.

[e] Includes in 1907: Antimony, clay products, graphite, gypsum, infusorial earth, lime, sulphur.

[f] Includes in 1907: Precious stones, whetstones.

[g] Includes in 1907: Graphite, talc, and soapstone.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

NEW MEXICO.

Product.	Quantity.	Value.
Clay products		$180,284
Coal...short tons	2,628,959	3,832,128
Copper...pounds	10,140,140	2,028,028
Gold...fine ounces (troy)	15,964	330,000
Lead...short tons	1,927	204,262
Lime...do	485	3,866
Mineral waters...gallons sold	65,800	9,120
Precious stones		1,570
Sand and gravel...short tons	209,478	50,724
Silver...fine ounces (troy)	599,500	395,700
Stone		381,011
Tungsten		4,320
Zinc...short tons	136	16,048
Other products		[a] 80,782
Total		7,517,843

NEW YORK.

Product.	Quantity.	Value.
Cement, natural...barrels	947,929	$633,170
Portland...do	2,290,955	2,433,918
Clay products		11,772,874
Gypsum		800,225
Iron, pig...long tons	1,659,752	33,097,000
Lime...short tons	137,111	652,205
Metallic paint and mortar colors...do	6,394	70,771
Millstones		23,072
Mineral waters...gallons sold	7,176,815	686,574
Natural gas		766,157
Petroleum...barrels	1,212,300	2,127,748
Salt...do	9,642,178	2,335,150
Sand and gravel...short tons	5,254,896	1,767,521
Sand-lime brick		75,462
Slate		83,485
Stone		6,993,705
Talc, fibrous...short tons	67,800	626,000
Other products		[b] 533,156
Total		68,762,815

NORTH CAROLINA.

Product.	Quantity.	Value.
Barytes...short tons	5,785	$18,855
Clay products		1,315,822
Coal		(c)
Copper...pounds	544,040	108,808
Gold...fine ounces (troy)	3,807	78,700
Lime...short tons	5,000	24,010
Mica		225,206
Millstones		1,969
Mineral waters...gallons sold	193,479	40,302
Monazite and zircon...pounds	457,067	54,870
Precious stones		7,580
Sand and gravel...short tons	4,745	2,191
Sand-lime brick		38,808
Silver...fine ounces (troy)	25,200	16,600
Stone		932,909
Talc and soapstone...short tons	4,085	74,347
Other products		[d] 20,404
Total		2,961,381

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[a] Includes in 1907: Gypsum, mica, and salt.

[b] Includes in 1907: Arsenic, aluminum, puzzolan cement, emery, feldspar, graphite, abrasive garnet, infusorial earth, pyrite, quartz, sienna, shale.

[c] Included under Georgia.

[d] Includes in 1907: Abrasive garnet, quartz, tin.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

NORTH DAKOTA.

Product.	Quantity.	Value.
Clay products		$287,919
Coal short tons	347,760	560,199
Natural gas		235
Stone		3,260
Other products		[a] 23,567
Total		875,180

OHIO.

Cement, Portland barrels	1,151,176	$1,377,155
Clay products		30,340,830
Coal short tons	32,142,419	35,324,746
Glass sand do	95,449	104,127
Grindstones and pulpstones		764,276
Iron, pig long tons	5,250,687	106,387,000
Lime short tons	322,917	1,239,912
Mineral waters gallons sold	1,536,621	121,531
Natural gas		8,718,562
Petroleum barrels	12,207,448	14,769,888
Pyrite long tons	6,816	20,803
Salt barrels	3,851,243	979,078
Sand and gravel short tons	2,883,352	1,411,910
Sand-lime brick		11,283
Stone		5,157,970
Other products		[b] 928,268
Total		207,657,339

OKLAHOMA (INCLUDING INDIAN TERRITORY).

Asphalt short tons	5,038	$20,770
Clay products		664,512
Coal short tons	3,642,658	7,433,914
Lead do	404	42,824
Mineral waters gallons sold	69,725	7,345
Natural gas		417,221
Petroleum barrels	43,524,128	17,513,524
Salt do	800	910
Sand and gravel short tons	108,560	22,506
Stone		274,326
Zinc short tons	719	84,842
Other products		[c] 426,274
Total		26,908,968

OREGON.

Clay products		$545,839
Coal short tons	70,981	166,304
Copper pounds	518,694	103,739
Gold fine ounces (troy)	59,124	1,222,200
Lime short tons	4,095	39,738
Mineral waters gallons sold	24,225	5,556
Natural gas		100
Platinum fine ounces (troy)	57	1,691
Sand and gravel short tons	504,142	289,422
Silver fine ounces (troy)	96,000	63,400
Stone		127,279
Other products		[d] 73,419
Total		2,638,587

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[a] Includes in 1907: Natural cement, sand-lime brick.

[b] Includes in 1907: Bromine, natural and puzzolan cement, gypsum, metallic paint and mortar colors, oilstones.

[c] Includes in 1907: Gypsum, lime.

[d] Includes in 1907: Cobalt oxide, gypsum, precious stones.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

PENNSYLVANIA.

Product.	Quantity.	Value.
Cement:		
Natural ... barrels	625,871	$263,969
Portland ... do	20,393,965	19,698,006
Clay products		20,291,621
Coal:		
Anthracite ... long tons	76,432,421	163,584,056
Bituminous ... short tons	150,143,177	155,664,026
Glass sand ... do	370,977	489,989
Graphite ... pounds	1,674,000	51,960
Iron, pig ... long tons	11,348,549	234,952,000
Lime ... short tons	655,166	2,075,842
Metallic paint and mortar colors ... do	10,327	127,973
Millstones		2,016
Mineral waters ... gallons sold	1,287,063	235,807
Natural gas		18,844,156
Ocher ... short tons	8,047	76,816
Petroleum ... barrels	9,999,306	17,579,706
Sand and gravel ... short tons	5,428,471	2,292,579
Sand-lime brick		48,410
Slate		3,855,640
Stone		9,132,372
Other products		[a] 6,874,095
Total		657,783,345

RHODE ISLAND.

Mineral waters ... gallons sold	245,307	$17,108
Stone		674,898
Other products		[b] 245,378
Total		937,384

SOUTH CAROLINA.

Clay products		$843,379
Glass sand ... short tons	3,000	2,400
Gold ... fine ounces (troy)	2,811	58,100
Manganese ores ... long tons	800	4,800
Mica		13,935
Mineral waters ... gallons sold	786,754	195,182
Monazite ... pounds	91,085	10,930
Phosphate rock ... long tons	257,221	980,867
Sand and gravel ... short tons	2,824	2,018
Silver ... fine ounces (troy)	100	100
Stone		129,377
Other products		[c] 64,115
Total		2,305,203

SOUTH DAKOTA.

Clay products		$40,107
Gold ... fine ounces (troy)	200,185	4,138,200
Lime ... short tons	3,673	24,895
Natural gas		19,500
Precious stones		5,200
Silver ... fine ounces (troy)	106,600	70,400
Stone		155,875
Other products		[d] 484,652
Total		4,938,829

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[a] Includes in 1907: Bromine, aluminum, puzzolan cement, abrasive garnet, abrasive quartz, feldspar, precious stones, quartz, salt, sienna, shale, talc, umber, zinc oxide.

[b] Includes in 1907: Clay products, lime, talc.

[c] Includes in 1907: Fuller's earth, lime, quartz, tin.

[d] Includes in 1907: Portland cement, gypsum, mica, mineral waters, sand-lime brick, sand and gravel, tin, tantalum.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

TENNESSEE.

Product.		Quantity.	Value.
Barytes	short tons	20,861	$37,138
Clay products			1,613,862
Coal	short tons	6,810,243	8,490,334
Copper	pounds	19,475,119	3,895,024
Gold	fine ounces (troy)	184	3,800
Iron, pig	long tons	393,106	7,542,000
Lead	short tons	16	1,696
Lime	do	66,699	263,323
Manganese ores	long tons	100	1,500
Mineral waters	gallons sold	758,312	85,249
Natural gas			300
Petroleum	barrels		(*a*)
Phosphate rock	long tons	638,612	3,047,836
Sand and gravel	short tons	794,364	313,211
Silver	fine ounces (troy)	58,300	38,500
Stone			1,090,121
Zinc	short tons	181	21,358
Other products			[b] 79,752
Total			26,525,004

TEXAS.

Product.		Quantity.	Value.
Asphalt	short tons	53,649	$929,857
Clay products			2,557,561
Coal	short tons	1,648,069	2,778,811
Gold	fine ounces (troy)	48	1,000
Lead	short tons	10	1,060
Lime	do	38,101	186,372
Mineral waters	gallons sold	1,146,279	152,233
Natural gas			[c] 178,276
Petroleum	barrels	12,322,696	10,410,865
Quicksilver	flasks	3,686	148,387
Salt	barrels	356,086	226,540
Sand and gravel	short tons	283,484	142,294
Silver	fine ounces (troy)	305,300	201,500
Stone			497,962
Zinc	short tons	16	1,888
Other products			[d] 1,391,854
Total			19,806,458

UTAH.

Product.		Quantity.	Value.
Asphalt	short tons	20,719	$569,440
Clay products			633,387
Coal	short tons	1,947,607	2,959,769
Copper	pounds	66,418,370	13,283,674
Gold	fine ounces (troy)	247,758	5,121,600
Lead	short tons	61,699	6,540,094
Lime	do	12,671	68,085
Precious stones			9,500
Quicksilver	flasks	460	18,000
Salt	barrels	345,557	199,779
Silver	fine ounces (troy)	11,406,900	7,528,500
Stone			338,382
Zinc	short tons	1,972	232,696
Other products			[e] 596,852
Total			38,099,756

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[a] Included under Kentucky.

[b] Includes in 1907: Bauxite, metallic paint and mortar colors.

[c] Includes Alabama and Louisiana.

[d] Includes in 1907: Natural and Portland cement, fuller's earth, gypsum, pig iron, precious stones, sand-lime brick.

[e] Includes in 1907: Antimony, Portland cement, gypsum, mineral waters, petroleum, phosphate rock, sand and gravel, and sulphur.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

VERMONT.

Product.	Quantity.	Value.
Clay products		$109,500
Copper .... pounds	696,102	139,220
Lime .... short tons	47,369	254,281
Mineral waters .... gallons sold	88,550	19,948
Sand and gravel .... short tons	78,734	33,410
Silver .... fine ounces (troy)	3,800	2,500
Slate		1,477,259
Stone		7,313,739
Talc and soapstone .... short tons	16,200	82,500
Other products		[a] 32,500
Total		9,464,857

VIRGINIA.

Barytes .... short tons	9,254	$32,833
Clay products		1,611,335
Coal .... short tons	4,710,895	4,807,533
Copper .... pounds	57,008	11,402
Glass sand .... short tons	1,246	4,535
Gold .... fine ounces (troy)	402	8,300
Iron, pig .... long tons	478,771	8,963,000
Lead .... short tons	82	8,692
Lime .... do	115,155	447,307
Manganese ores .... long tons	4,604	56,469
Mica		1,014
Millstones		4,684
Mineral waters .... gallons sold	2,442,075	431,770
Precious stones		520
Pyrite .... long tons	124,740	372,586
Sand and gravel .... short tons	266,976	119,277
Silver .... fine ounces (troy)	200	100
Slate		173,670
Stone		760,488
Talc and soapstone .... short tons	26,278	631,880
Zinc .... do	771	90,978
Other products		[b] 774,809
Total		19,313,182

WASHINGTON.

Clay products		$921,934
Coal .... short tons	3,680,532	7,679,801
Copper .... pounds	122,263	24,453
Gold .... fine ounces (troy)	12,689	262,300
Lead .... short tons	281	29,786
Lime .... do	35,913	238,568
Mineral waters .... gallons sold	68,400	10,820
Sand and gravel .... short tons	403,960	179,800
Silver .... fine ounces (troy)	84,000	55,400
Stone		920,254
Tungsten		32,500
Other products		[c] 262,090
Total		11,617,706

WEST VIRGINIA.

Clay products		$3,640,387
Coal .... short tons	48,091,583	47,846,630
Glass sand .... do	171,338	225,003
Iron, pig .... long tons	291,066	6,454,000
Lime .... short tons	107,895	290,298
Mineral waters .... gallons sold	135,809	79,659
Natural gas		16,670,962
Petroleum .... barrels	9,095,296	15,852,428
Salt .... do	156,147	76,527
Sand and gravel	333,246	160,435
Stone		1,053,867
Other products		[d] 137,764
Total		92,487,960

[a] Includes in 1907: Ocher, oilstones.
[b] Includes in 1907: Natural and Portland cement, feldspar, gypsum, ocher, rutile, sand-lime brick.
[c] Includes in 1907: Antimony, arsenic, Portland cement, precious stones, sand-lime brick.
[d] Includes in 1907: Bromine, Portland cement, grindstones.

Output and value, by States and Territories, of the mineral products of the United States in the calendar year 1907—Continued.

WISCONSIN.

Product.		Quantity.	Value.
Clay products			$1,127,819
Glass sand	short tons	2,970	1,930
Lead	do	3,551	376,406
Lime	do	219,644	733,996
Mineral waters	gallons sold	6,839,219	1,526,703
Sand and gravel	short tons	964,689	278,464
Stone			2,492,141
Zinc	short tons	15,273	1,802,214
Other products			[a] 5,494,652
Total			13,832,395

WYOMING.

Product.		Quantity.	Value.
Clay products			$88,340
Coal	short tons	6,252,990	9,732,668
Copper	pounds	3,026,004	605,201
Gold	fine ounces (troy)	455	9,400
Gypsum			125,033
Lime	short tons	282	3,220
Natural gas			([b])
Precious stones			600
Silver	fine ounces (troy)	1,600	1,100
Stone			51,262
Other products			[c] 54,750
Total			10,671,574

MISCELLANEOUS PRODUCTS.

Product.	Quantity.	Value.
Antimony, copper, lead, lime, lithium minerals, natural gas, pearls, pottery, stone		$1,743,304

[a] Includes in 1907: Natural cement, graphite, pig iron, abrasive quartz, metallic paint and mortar colors, petroleum, sand-lime brick.

[b] Included under Miscellaneous.

[c] Includes in 1907: Mineral waters petroleum, phosphate rock, sand and gravel, sulphur.

RECAPITULATION.

Alabama	$52,136,749	New Hampshire	$1,390,360
Alaska	20,200,552	New Jersey	32,800,299
Arizona	56,753,650	New Mexico	7,517,843
Arkansas	6,386,747	New York	68,762,815
California	56,679,436	North Carolina	2,961,381
Colorado	71,105,128	North Dakota	875,180
Connecticut	3,389,519	Ohio	207,657,339
Delaware	431,438	Oklahoma	26,908,968
District of Columbia	337,294	Oregon	2,638,587
Florida	7,365,754	Pennsylvania	657,783,345
Georgia	6,641,003	Rhode Island	937,384
Idaho	21,300,612	South Carolina	2,305,203
Illinois	145,768,464	South Dakota	4,938,829
Indiana	39,141,217	Tennessee	26,525,004
Iowa	17,623,094	Texas	19,806,458
Kansas	28,577,044	Utah	38,099,756
Kentucky	19,294,341	Vermont	9,464,857
Louisiana	10,876,719	Virginia	19,313,182
Maine	4,379,073	Washington	11,617,706
Maryland	19,356,250	West Virginia	92,487,960
Massachusetts	6,584,181	Wisconsin	13,832,395
Michigan	70,073,920	Wyoming	10,671,574
Minnesota	5,457,422		
Mississippi	1,024,302	Total	2,067,445,892
Missouri	53,129,431	Miscellaneous	1,743,304
Montana	60,663,511	Unspecified products	100,000
Nebraska	1,383,916		
Nevada	22,088,700	Grand total	2,069,289,196

IRON ORES, PIG IRON, AND STEEL.

By Edwin C. Eckel.

ACKNOWLEDGMENTS.

The data on iron-ore production which form the basis of the following report are collected directly by the United States Geological Survey. As both the promptness of publication and the final value of the report depend chiefly on the manner in which the requests for statistics are answered, it is a pleasure to acknowledge the cordiality and completeness with which the mine owners and managers of the country have replied.

In connection with the data on the United States iron-ore industry during 1907 it seems desirable to present a brief summary of the principal facts relative to the pig-iron and steel industries during the same period. Through the courtesy of Mr. James M. Swank, general manager of the American Iron and Steel Association, these statistics are available for the present publication. They have been abridged considerably and rearranged slightly in order to adapt them better to the purposes of the present volume.

It must also be noted that several tables relative to the shipment and receipt of Lake ores are here presented through the courtesy of the Iron Trade Review, from whose columns they are quoted.

IRON INDUSTRY IN 1907.

Though the year 1907 closed with records broken in the production both of iron ores and of pig iron, the increase in the latter over 1906 was slight compared with the gain which had been expected earlier in the year. The first half of 1907, for example, showed a pig-iron production of 13,478,044 tons, indicating that the total for the year might be 27,000,000 tons, or thereabouts. As a matter of fact, the year's total output was only 25,781,361 tons, the second half showing a falling off of over a million tons as compared with the first half. This was of course the result of the abrupt and extensive shut downs which marked the last quarter of 1907.

The year opened with a strained financial position, both at home and abroad. This grew steadily worse, but until October it exerted little apparent effect upon the industrial as distinguished from the financial activities of the country. Furnaces and mills were pushed to their uttermost during the spring, summer, and early fall; and this activity seemed to be justified by the accumulation of orders, though about the middle of the year new orders became less pressing and prices softened somewhat. The third quarter ended with everything in full blast, but hardly a month was required for a most remarkable change in conditions. The October panic brought with it not only absolute cessation of new orders, but widespread attempts to delay or cancel orders already on the books. The situation was met by prompt shut downs of many furnaces and mills, and the year closed with most companies operating only from 30 to 40 per cent of their capacity. The rapidity of the decline is best indicated, perhaps, by the manner in which the earnings of the United States Steel Corporation fell off during these last months of 1907. For September the Steel Corporation reported earnings of $14,720,945, which increased to the record figure of $17,052,210 in October. The earnings for November, the first month to show the effects of the depression, fell off to $10,467,252, and in December they further declined to $5,014,728. These earnings came from so wide a variety of iron and steel products that they furnish a better idea of the rapidity and extent of the business depression than would any more limited set of figures.

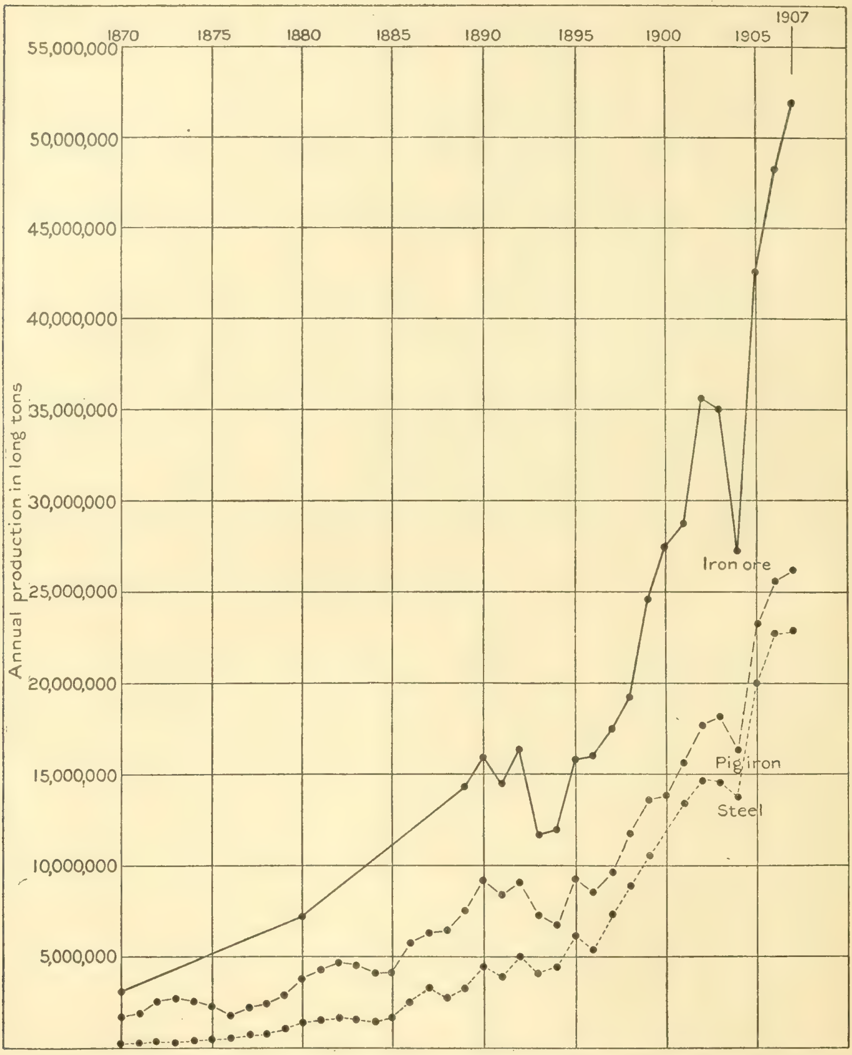

FIG. 1.—Curve showing the production of iron ore, pig iron, and steel in the United States, 1870–1907, in long tons.

The promptness with which manufacturers shut down their furnaces and mills in October resulted in a marked decrease in the rate of iron and steel production during the last quarter of the year. The total output for the year shows, therefore, only slight increases over 1906 in place of the heavy gains anticipated.

With regard to the iron-ore production, the case is different. By far the greater bulk of the Lake ore shipments for 1907 had left the mines before the depression set in, and the iron-ore output for 1907 therefore shows a heavy increase over that of 1906. An unprecedented proportion of this tonnage, however, was carried over in stock for the 1908 season.

The relation of the year 1907 to the recent past of the iron industry is shown graphically in the accompanying diagram (fig. 1). On this diagram the production of iron ore, pig iron, and steel in the United States for the years 1870 to 1907, inclusive, is plotted. On examination of these curves it will be seen that the rapid uplift from the depression of 1903–4 culminated during 1907 in a manner strikingly similar to that in which the rise of 1896–1902 came to an end. The parallel is likely to be carried further, for it is now practically certain that the year 1908 will show an actual decrease in the output of iron ore and pig iron, just as was shown by the year 1904.

IRON-ORE PRODUCTION OF THE UNITED STATES.

PRODUCTION BY STATES.

The iron ore produced in the United States during 1907 amounted to 51,720,619 long tons, valued at $131,996,147 at the mines. As compared with the production of 1906, the most productive previous year, this was an increase of 8.32 per cent in tonnage and of 31.21 per cent in value.

In the following table the production of 1907 is given by States; that of 1906 has been added for comparison:

Quantity and value of iron ore produced in the United States, 1906 and 1907, by States.

State.	1906.		1907.		Increase (+) or decrease (−) in 1907.		Percentage of increase (+) or decrease (−) in 1907.	
	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.
Alabama	3,995,098	$5,123,539	4,039,453	$4,863,129	+ 44,355	− $260,410	+ 1.11	− 5.08
Arkansas and Texas	[a] 36,660	36,660	118,667	120,060	+ 82,007	+ 83,400	+223.70	+227.50
Colorado	14,078	22,525	11,714	21,085	− 2,364	− 1,440	− 16.79	− 6.39
Connecticut and Massachusetts	31,343	94,129	37,166	136,440	+ 5,823	+ 42,311	+ 18.58	+ 44.95
Georgia	411,230	734,780	444,114	837,102	+ 32,884	+ 102,322	+ 8.00	+ 13.93
Kentucky, Maryland, and West Virginia	46,940	58,175	62,808	95,891	+ 15,868	+ 37,716	+ 33.80	+ 64.83
Michigan	11,822,874	31,145,087	11,830,342	36,441,330	+ 7,468	+ 5,296,243	+ .06	+ 17.01
Minnesota	25,364,077	51,799,256	28,969,658	76,668,836	+3,605,581	+24,869,580	+ 14.22	+ 48.01
Missouri	80,910	158,109	[b] 111,768	[b] 226,286	+ 30,858	+ 68,177	+ 38.14	+ 43.12
Montana, Nevada, New Mexico, Utah, and Wyoming	792,190	946,551	[c] 819,544	[c] 967,190	+ 27,354	+ 20,639	+ 3.45	+ 2.18
New Jersey	542,518	1,570,578	549,760	1,815,586	+ 7,242	+ 245,008	+ 1.33	+ 15.60
New York	1,041,992	2,635,639	1,375,020	2,820,135	+ 333,028	+ 184,496	+ 31.96	+ 7.00
North Carolina	56,057	75,638	50,439	113,488	− 5,618	+ 37,850	− 10.02	+ 50.04
Ohio	17,384	29,706	23,589	41,081	+ 6,205	+ 11,375	+ 35.69	+ 38.29
Pennsylvania	949,429	1,246,267	837,287	1,298,717	− 112,142	+ 52,450	− 11.81	+ 4.21
Tennessee	870,734	1,307,433	813,690	1,325,134	− 57,044	+ 17,701	− 6.55	+ 1.35
Virginia	828,081	1,579,817	786,856	1,538,920	− 41,225	− 40,897	− 4.98	− 2.59
Wisconsin	848,133	2,033,217	838,744	2,665,737	− 9,389	+ 632,520	− 1.11	+ 31.11
Total	47,749,728	100,597,106	51,720,619	131,996,147	+3,970,891	+31,399,041	+ 8.32	+ 31.21

[a] Texas alone. [b] Includes Iowa. [c] Includes California and Washington.

RANK OF STATES AS IRON-ORE PRODUCERS.

In the following table the various iron-ore producing States are arranged in order according to their production in 1906 and 1907. On comparison of the figures it will be noted that the four leading States hold the same rank in 1907 as in 1906, and they occupied the same positions in 1905. Wisconsin, however, which fell to seventh place in 1906, passed both Pennsylvania and Tennessee in 1907 and regained its 1905 rank as fifth State.

Rank of iron-ore producing States in 1906 and 1907, with quantity and value of product and percentage of each.

1906.

Rank.	State.	Production.		Rank.	State.	Value.	
		Quantity, in long tons.	Percentage of total production.			Amount.	Percentage of total.
1	Minnesota	25,364,077	53.12	1	Minnesota	$51,799,256	51.49
2	Michigan	11,822,874	24.76	2	Michigan	31,145,087	30.96
3	Alabama	3,995,098	8.37	3	Alabama	5,123,539	5.09
4	New York	1,041,992	2.18	4	New York	2,635,639	2.62
5	Pennsylvania	949,429	1.99	5	Wisconsin	2,033,217	2.02
6	Tennessee	870,734	1.82	6	Virginia	1,579,817	1.57
7	Wisconsin	848,133	1.78	7	New Jersey	1,570,578	1.56
8	Virginia	828,081	1.73	8	Tennessee	1,307,433	1.30
9	Montana, Nevada, New Mexico, Utah, and Wyoming	792,190	1.66	9	Pennsylvania	1,246,267	1.24
10	New Jersey	542,518	1.14	10	Montana, Nevada, New Mexico, Utah, and Wyoming	946,551	.94
11	Georgia	411,230	.86	11	Georgia	734,780	.73
12	Missouri	80,910	.17	12	Missouri	158,109	.16
13	North Carolina	56,057	.12	13	Connecticut and Massachusetts	94,129	.09
14	Kentucky, Maryland, and West Virginia	46,940	.10	14	North Carolina	75,638	.08
15	Arkansas and Texas	[a]36,660	.07	15	Kentucky, Maryland, and West Virginia	58,175	.06
16	Connecticut and Massachusetts	31,343	.06	16	Arkansas and Texas[a]	36,660	.04
17	Ohio	17,384	.04	17	Ohio	29,706	.03
18	Colorado	14,078	.03	18	Colorado	22,525	.02
	Total	47,749,728	100.00		Total	100,597,106	100.00

1907.

Rank.	State.	Quantity, in long tons.	Percentage of total production.	Rank.	State.	Amount.	Percentage of total.
1	Minnesota	28,969,658	56.11	1	Minnesota	$76,668,836	58.08
2	Michigan	11,830,342	22.87	2	Michigan	36,441,330	27.61
3	Alabama	4,039,453	7.81	3	Alabama	4,863,129	3.69
4	New York	1,375,020	2.66	4	New York	2,820,135	2.14
5	Wisconsin	838,744	1.62	5	Wisconsin	2,665,737	2.02
6	Pennsylvania	837,287	1.62	6	New Jersey	1,815,586	1.38
7	Montana, Nevada, New Mexico, Utah, and Wyoming	[b]819,544	1.59	7	Virginia	1,538,920	1.17
8	Tennessee	813,690	1.57	8	Tennessee	1,325,134	1.00
9	Virginia	786,856	1.52	9	Pennsylvania	1,298,717	.98
10	New Jersey	549,760	1.06	10	Montana, Nevada, New Mexico, Utah, and Wyoming	[b]967,190	.73
11	Georgia	444,114	.86	11	Georgia	837,102	.63
12	Arkansas and Texas	118,667	.23	12	Missouri	[c]226,286	.17
13	Missouri	[c]111,768	.22	13	Connecticut and Massachusetts	136,440	.10
14	Kentucky, Maryland, and West Virginia	62,808	.12	14	Arkansas and Texas	120,060	.09
15	North Carolina	50,439	.10	15	North Carolina	113,488	.09
16	Connecticut and Massachusetts	37,166	.07	16	Kentucky, Maryland, and West Virginia	95,891	.07
17	Ohio	23,589	.05	17	Ohio	41,081	.03
18	Colorado	11,714	.02	18	Colorado	21,085	.02
	Total	51,720,619	100.00		Total	131,996,147	100.00

[a] Texas alone.

[b] Includes California and Washington.

[c] Includes Iowa.

VARIETIES OF IRON ORE PRODUCED.

The iron minerals which are used as ores of that metal fall, when considered from the chemical point of view, into two classes—oxides and carbonates. The latter are relatively very unimportant in the United States, furnishing less than one twentieth of 1 per cent of the total output. The important group of oxides, moreover, is separable on both commercial and scientific grounds into three subgroups, the ores of which differ in composition, grade, and geologic associations.

The final grouping used in this report is, therefore, as follows, the varieties being named in order of their present productive importance:

1. *Red hematite:* Including all the anhydrous sesquioxides known locally as red hematite, specular ore, fossil ore, oolitic ore, etc.
2. *Brown ore:* Including limonite, gothite, and other hydrous sesquioxides known locally as brown iron ores, bog ores, etc.
3. *Magnetite:* Including the magnetic oxides.
4. *Carbonate:* Including the iron carbonates of various types.

In the following table the total production in the United States is classified according to variety of ore. It will be seen that the group of hematites is not only the most important, producing now almost nine-tenths of the total, but that its relative importance increases each year. This is due to the fact that in the two great producing regions of the country—the Lake Superior area and the Birmingham district—red hematites are the principal sources of ore supply.

Far below the red hematites in order of importance come the brown ores and the magnetites, each of which classes includes about one-twentieth of the present annual production of the country. The carbonates are of slight and steadily decreasing relative importance.

Production of iron ores in the United States, by varieties, 1889–1907, in long tons.

Year.	Brown ore.	Red hematite.	Magnetite.	Carbonate.	Total.
1889	2,523,087	9,056,288	2,506,415	432,251	14,518,041
1890	2,559,938	10,527,650	2,570,838	377,617	16,036,043
1891	2,757,564	9,327,398	2,317,108	189,108	14,591,178
1892	2,485,101	11,646,619	1,971,965	192,981	16,296,666
1893	1,849,272	8,272,637	1,330,886	134,834	11,587,629
1894	1,472,748	9,347,434	972,219	87,278	11,879,679
1895	2,102,358	12,513,995	1,268,222	73,039	15,957,614
1896	2,126,212	12,576,288	1,211,526	91,423	16,005,449
1897	1,961,954	14,413,318	1,059,479	83,295	17,518,046
1898	1,989,681	16,150,684	1,237,978	55,373	19,433,716
1899	2,869,785	20,004,399	1,727,430	81,559	24,683,173
1900	3,231,089	22,708,274	1,537,551	76,247	27,553,161
1901	3,016,715	24,006,025	1,813,076	51,663	28,887,479
1902	3,305,484	30,532,149	1,688,860	27,642	35,554,135
1903	3,080,399	30,328,654	1,575,422	34,833	35,019,308
1904	2,146,795	23,839,477	1,638,846	19,212	27,644,330
1905	2,546,662	37,567,055	2,390,417	21,999	42,526,133
1906	2,781,063	42,481,375	2,469,294	17,996	47,749,728
1907	2,957,477	46,060,486	2,679,067	23,589	51,720,619
Total	47,763,384	391,360,205	33,966,599	2,071,939	475,162,127
Percentage of totals for nineteen years	10.1	82.4	7.1	0.4	....
Percentage of total for 1907	5.7	89.1	5.2	....	....

A good idea of the geographic distribution of the different varieties of iron ore is given in the table following, where the total production is classified as to both varieties and States. The red hematites and brown ores are widely distributed in the United States, every State in the table except Ohio and North Carolina having a production of one or both of these classes. The magnetite production, on the other hand, is confined at present to two groups of States, one along the Appalachian Range and the other in the Rocky Mountain region. Ohio is the only State in which carbonate ores were mined during 1907.

Production of iron ore in the United States in 1906 and 1907, by States and varieties, in long tons.

1906

State.	Brown ore.	Red hematite.	Magnetite.	Carbonate.	Total quantity.
Alabama	821,301	3,173,797			3,995,098
Arkansas and Texas	[a] 36,660				36,660
Colorado	14,078				14,078
Connecticut and Massachusetts	31,343				31,343
Georgia	305,624	105,606			411,230
Kentucky, Maryland, and West Virginia	18,895	27,433		612	46,940
Michigan		11,822,874			11,822,874
Minnesota		25,364,077			25,364,077
Missouri	41,805	39,105			80,910
Montana, Nevada, New Mexico, Utah, and Wyoming		[b] 620,635	171,555		[c] 792,190
New Jersey	20,611		521,907		542,518
New York	1,000	128,385	912,607		1,041,992
North Carolina			56,057		56,057
Ohio				17,384	17,384
Pennsylvania	134,027	8,854	806,548		949,429
Tennessee	590,763	279,971			870,734
Virginia	735,204	92,257	620		828,081
Wisconsin	29,752	818,381			848,133
Total	2,781,063	42,481,375	2,469,294	17,996	47,749,728
1907.					
Alabama	895,442	3,144,011			4,039,453
Arkansas and Texas	118,667				118,667
Colorado	11,714				11,714
Connecticut and Massachusetts	37,166				37,166
Georgia	337,229	106,885			444,114
Kentucky, Maryland, and West Virginia	26,808	36,000			62,808
Michigan		11,830,342			11,830,342
Minnesota		28,969,658			28,969,658
Missouri	[d] 69,241	42,527			111,768
Montana, Nevada, New Mexico, Utah, and Wyoming	[e] 16,000	608,056	[f] 195,488		819,544
New Jersey	46,818		502,942		549,760
New York	10,000	140,101	1,224,919		1,375,020
North Carolina			50,439		50,439
Ohio				23,589	23,589
Pennsylvania	113,076	19,403	704,808		837,287
Tennessee	544,508	269,182			813,690
Virginia	696,518	89,867	471		786,856
Wisconsin	34,290	804,454			838,744
Total	2,957,477	46,060,486	2,679,067	23,589	51,720,619

[a] Texas alone.
[b] Includes a small quantity of brown hematite.
[c] Includes some ore used as smelter flux.
[d] Includes Iowa.
[e] Includes Washington.
[f] Includes California.

PRICE OF IRON ORE PER TON.

The following table presents data on the price per ton of the different varieties of iron ore in the various producing States. The prices given are intended to represent value at the mouth of the mine and are taken directly from the replies of the producers. It is probably unnecessary to caution the reader that any such table must be accepted as merely a fair approximation to the truth. The element of inaccuracy arises from conditions in the iron-ore business and can not be readily overcome. By far the bulk of the iron ore produced in the United States is mined directly by pig-iron producers for use in their own furnaces, and the valuation which they place on such ore is therefore entirely a matter of accounting. Some of the reports made to the Survey evidently include merely actual mining costs;

others contain an allowance for sinking fund; and in still others the figures given are obviously merely convenient prices to use in charging costs against the blast furnaces.

It is to be noted, however, that the errors are almost entirely in one direction—that of undervaluing the ore rather than of overvaluing it. If all of the iron ore were to be bought by iron furnaces in open market from an entirely distinct set of iron-ore miners, the average prices paid would probably be considerably in excess of those now reported.

Average price per long ton of iron ore in the United States in 1907, by States and varieties.

State.	Brown ore.	Red hematite.	Magnetite.	Carbonate.
Alabama	$1.58	$1.10		
Arkansas and Texas	1.01			
Colorado	1.80			
Connecticut and Massachusetts	3.67			
Georgia	1.97	1.62		
Kentucky, Maryland, and West Virginia	2.16	1.06		
Michigan		3.08		
Minnesota		2.65		
Missouri	[a]2.04	2.00		
Montana, Nevada, New Mexico, Utah, and Wyoming	[b]1.50	1.22	[c]$1.04	
New Jersey	2.48		3.38	
New York	3.50	2.49	1.99	
North Carolina			2.25	
Ohio				$1.74
Pennsylvania	2.53	2.06	1.38	
Tennessee	1.69	1.50		
Virginia	1.95	1.96	3.27	
Wisconsin	1.79	3.24		
Total average	1.81	2.63	2.03	1.74

[a] Iowa included. [b] Washington included. [c] California included

PRINCIPAL IRON-ORE MINES OF THE UNITED STATES.

During 1907, 169 mines produced over 50,000 long tons of iron ore each, the maximum production of any one mine being 2,900,624 tons from the Hull-Rust, of Minnesota. Ten mines, all except one being located in Minnesota, produced over 1,000,000 tons each. The one 1,000,000-ton mine not located in Minnesota was the Red Mountain, of Alabama, which during 1907 produced 1,370,849 tons and ranked seventh in the list.

Permission has been obtained from the owners to publish the names and output of 152 of these large producers, and this information is presented in the following table. It will be noted that gaps occur in the series of numbers in the column headed "Rank." The missing numbers belong to mines whose owners refused permission to publish name and output.

Iron-ore mines of the United States that produced more than 50,000 long tons each in 1907.

Rank.	Name of mine.	State.	Variety of ore.[a]	Quantity.
1	Hull Rust	Minnesota		2,900,624
2	Morris	do		2,076,521
3	Mountain Iron	do		1,973,266
4	Fayal	do		1,892,974
5	Mahoning	do		1,563,064
6	Burt	do		1,501,288
7	Red Mountain Group	Alabama		1,370,849
8	Stevenson	Minnesota		1,163,813
9	Adams	do		1,114,325
10	Virginia Group	do		1,015,763
11	Pioneer	do		839,751
12	Buyabik	do		810,181

[a] **Red hematite except where specified. Some of the Michigan mines produce magnetite in subordinate quantities.**

Iron-ore mines of the United States that produced more than 50,000 long tons each in 1907—Continued.

Rank.	Name of mine.	State.	Variety of ore.	Quantity.
13	Chapin	Michigan		795,376
14	Norrie Group	do		764,358
15	Cornwall	Pennsylvania	Magnetite	704,208
16	Spruce	Minnesota		616,406
17	Sunrise	Wyoming		558,849
18	Cleveland Lake	Michigan		557,346
19	Newport	do		551,506
20	Lake Superior	do		527,775
21	Pillsbury	Minnesota		489,728
22	Commodore	do		479,316
23	Pewabic	Michigan		454,629
24	Albany	Minnesota		445,969
25	Aragon	Michigan		427,969
26	Lyon Mountain	New York	Magnetite	399,005
27	Penn	Michigan		396,699
29	Aurora	do		377,533
30	Monroe-Tener	Minnesota		367,693
32	Old Bed	New York	Magnetite	354,430
33	Bristol	Michigan		354,030
35	Croxton	Minnesota		335,409
36	Hartley	do		334,646
37	Hartford	Michigan		333,839
38	Clark	Minnesota		318,094
39	Savoy-Sibley	do		312,363
40	Ashland	Michigan		305,612
41	Negaunee	do		304,249
42	Leetonia	Minnesota		301,367
43	Utica	do		299,856
44	La Rue	do		295,703
45	Cliffs Shaft	Michigan		295,701
46	Tobin and Genesee	do		293,055
47	Miller	Minnesota		284,100
49	Lake Angeline	Michigan		271,638
50	Hawkins	Minnesota		268,574
51	Cyprus	do		260,882
52	Iroquois	do		257,280
53	Great Western and Lincoln	Michigan		256,580
54	Chisholm	Minnesota		253,567
55	Crosby	do		240,834
56	Zenith	do		238,796
57	Chandler	do		226,754
58	Queen Group	Michigan		223,004
59	Rust	Minnesota		210,493
60	Yates	do		208,148
61	Glen	do		207,913
62	Odanah	Wisconsin		207,523
63	Ironton	Michigan		199,536
64	Baltic	do		197,758
65	Fierro	New Mexico		192,488
66	Austin	Michigan		192,424
67	Lincoln	Minnesota		186,304
68	Port Henry, No. 21	New York	Magnetite	185,118
69	Tilden	Michigan		179,881
70	Mikado	do		178,444
71	Princeton	do		174,457
72	Florence	Wisconsin		174,257
73	Higgins	Minnesota		173,550
74	Corsica	do		169,763
75	Harmony	New York	Magnetite	166,565
76	Republic	Michigan		165,624
77	Brown Mining Company	Tennessee	Brown ore	164,722
78	Mary Charlotte	Michigan		163,978
79	Brunt	Minnesota		160,076
80	Montreal	Wisconsin		158,538
81	Wacoutah	Minnesota		157,881
82	Hull	do		155,362
83	Myers	do		152,794
84	Sellers	do		152,550
85	Agnew	do		147,594
86	Dunn	Michigan		145,914
87	Minorca	Minnesota		145,108
88	Laura	do		143,002
89	Elba	do		142,010
90	Kinney	do		141,941
91	Caspian	Michigan		139,514
92	Leonard	Minnesota		137,360
93	St. Paul	do		137,316
94	Greeley	Alabama	Brown ore	132,088
95	Mohawk	Minnesota		131,712
96	Salisbury	Michigan		130,684
97	Cambria	do		129,314
98	Crudup	Alabama		121,000
99	Bartow	Georgia	Brown ore	120,000

Iron-ore mines of the United States that produced more than 50,000 long tons each in 1907—Continued.

Rank.	Name of mine.	State.	Variety of ore.	Quantity.
100	Alexander	Minnesota		119,278
102	Hemlock	Michigan		114,189
103	Mayas	Minnesota		113,519
104	Crystal Falls	Michigan		111,283
105	Susquehanna	Minnesota		109,799
106	Soudan	do		106,553
107	Champion	Michigan		104,660
108	Brotherton	do		103,964
109	Colby	do		103,098
110	Sunday Lake	do		102,143
111	Troy	Minnesota		101,905
112	Gilbert	do		100,178
114	Loretto and Appleton	Michigan		99,779
115	Oriskany	Virginia	Brown ore	99,600
118	Youngs	Michigan		95,000
119	Winnifred	Minnesota		94,839
120	Atlantic	Wisconsin		94,757
121	Genoa	Minnesota		93,791
122	Duluth	do		93,120
124	Ohio	Michigan		91,196
125	Riverton Group	do		91,089
126	Victoria	Minnesota		90,090
127	Helen-Bess	Alabama		89,628
128	Hurd	New Jersey	Magnetite	89,111
129	Breitung Hematite Mine, No. 2	Michigan		89,033
130	Estelle	Georgia		88,000
131	Lillie	Michigan		86,464
132	Clifford	do		83,094
133	Wharton	New Jersey	Magnetite	82,242
134	Mannie	Tennessee	Brown ore	81,528
135	Adriatic	Minnesota		81,420
136	Moro	Michigan		80,478
137	Bessemer	Minnesota		78,012
138	Richard	New Jersey	Magnetite	76,292
139	Malta	Minnesota		76,158
140	Paint River	Michigan		75,774
141	Mansfield	do		75,473
142	Johnson Hill	Texas	Brown ore	75,000
144	Pearce	Minnesota		74,058
147	Wood and De Camp	New Jersey	Magnetite	67,591
148	Hector	Minnesota		65,965
150	Eureka	Michigan		64,942
151	Illinois	Wisconsin		62,968
152	Jordan	Minnesota		61,997
154	Union	do		61,825
155	Jackson	Michigan		61,345
156	Valley View	Alabama		60,200
159	Calumet	Michigan		59,147
160	La Belle	Minnesota		56,300
161	Embree	Tennessee	Magnetite	55,494
162	Nanaimo	Michigan		54,257
163	Songo	Alabama		53,789
164	Vivian	Michigan		51,304
165	Ottawa	Wisconsin		50,959
166	Cranberry	North Carolina	Magnetite	50,439
168	Fairhaven	New York		50,000
169	Etowah	Georgia	Brown ore	50,000
	Total (152 mines)			45,691,968
	Unspecified (17 mines) [a]			2,382,687
	Grand total (169 mines)			48,074,655

[a] Includes the product of 17 mines producing over 50,000 long tons each, operated by 7 companies, which object to the publication of individual statistics.

STOCKS OF IRON ORE AT MINES.

The stock of ore on hand at mines on December 31, 1907, amounted to 3,033,110 long tons, as compared with a stock of 3,281,789 tons similarly held on December 31, 1906, and a stock of 3,812,281 tons on December 31, 1905. It should be noted, however, that while the stock on hand at the mines on December 31, 1907, was about 250,000 tons less than on the same date in 1906, the stock on hand at the lower Lake ports, as shown in a subsequent table, indicated an increase of over 1,130,000 tons.

Stock of iron ore on hand at the mines December 31, 1906 and 1907, by States, in long tons.

State.	1906.	1907.
Alabama	24,034	55,871
Georgia	2,061	
Maryland	225	800
Massachusetts	3,300	3,000
Michigan	1,991,074	1,546,946
Minnesota	996,902	1,095,789
Missouri	2,950	825
Montana and New Mexico	1,900	
New Jersey	5,608	45,107
New York	87,663	47,675
Ohio	15,573	14,548
Pennsylvania	11,365	7,747
Tennessee	36,230	11,773
Texas	6,000	89,050
Utah		50
Vermont		100
Virginia	460	3,231
Wisconsin	96,444	110,598
Total	3,281,789	3,033,110
Percentage of decrease in 1907		7.58

APPARENT ANNUAL IRON-ORE CONSUMPTION.

The following table includes data on certain factors from which an approximate estimate of the annual consumption of iron ore in the United States is deduced. The result is of course merely an approximation, for no data are available on certain factors which should enter into the final result. The elements accounted for in the table and estimate are (1) domestic iron-ore production; (2) stock of ore at mines; (3) imports of ore; (4) exports of ore; (5) stocks of ore at Lake ports; (6) zinc residuum production.

Apparent consumption of iron ore in the United States, 1889–1907, in long tons.

Year.	Domestic iron ore produced.	Stocks of ore at mines.	Imports.	Exports.	Stocks of ore at lower lake ports, Dec. 1.	Zinc residuum.	Apparent consumption.
1889	14,518,041	2,256,973	853,573		2,607,106	43,648	14,366,562
1890	16,036,043	2,000,000	1,246,830		3,893,487	48,560	16,302,025
1891	14,591,178	2,450,279	912,864		3,508,489	38,228	15,476,989
1892	16,296,666	2,911,740	806,585		4,149,451	31,859	16,032,687
1893	11,587,629	3,526,161	526,951		4,070,710	37,512	11,616,412
1894	11,879,679	3,236,198	167,307		4,834,247	26,981	11,600,393
1895	15,957,614	2,976,494	524,153		4,415,712	43,249	17,203,255
1896	16,005,449	3,405,302	682,806		4,954,984	44,953	15,765,128
1897	17,518,046	3,098,287	489,970		5,923,755	33,924	17,380,184
1898	19,433,716	2,846,457	187,208		5,136,407	48,502	20,708,604
1899	24,683,173	2,320,278	674,082	40,665	5,530,283	65,010	25,513,903
1900	27,553,161	3,709,950	897,831	51,460	5,904,670	87,110	26,722,583
1901	28,887,479	4,239,823	966,950	64,703	5,859,663	52,311	29,357,171
1902	35,554,135	3,834,717	1,165,470	88,445	7,074,254	65,246	35,886,921
1903	35,019,308	6,297,888	980,440	80,611	6,371,085	73,264	34,232,399
1904	27,644,330	4,666,931	487,613	213,865	5,763,399	68,189	30,224,910
1905	42,526,133	3,812,281	845,651	208,017	6,438,967	90,289	43,433,138
1906	47,749,728	3,281,789	1,060,390	265,240	6,252,455	93,461	49,355,343
1907	51,720,619	3,033,110	1,229,168	278,208	7,385,728	93,413	51,880,398

COMPARATIVE PRODUCTION OF IRON ORE AND PIG IRON.

Detailed data on the pig-iron production of the United States are presented on later pages of this report, but in the following table an interesting comparison is made between the annual production of iron ore and of pig iron.

Production of iron ore and pig iron in the United States, 1889–1907, in long tons.

Year.	Iron ore mined.	Pig iron produced.[a]	Year.	Iron ore mined.	Pig iron produced.[a]
1889	14,518,041	7,603,642	1899	24,683,173	13,620,703
1890	16,036,043	9,202,703	1900	27,553,161	13,789,242
1891	14,591,178	8,279,870	1901	28,887,479	15,878,354
1892	16,296,666	9,157,000	1902	35,554,135	17,821,307
1893	11,587,629	7,124,502	1903	35,019,308	18,009,252
1894	11,879,679	6,657,388	1904	27,644,330	16,497,033
1895	15,957,614	9,446,308	1905	42,526,133	22,992,380
1896	16,005,449	8,623,127	1906	47,749,728	25,307,191
1897	17,518,046	9,652,680	1907	51,720,619	25,781,361
1898	19,433,716	11,773,934			

[a] From annual reports of the American Iron and Steel Association.

OCCURRENCE AND PRODUCTION OF IRON ORE IN THE VARIOUS STATES AND DISTRICTS.

IRON-ORE DISTRICTS OF THE UNITED STATES.

Iron ore is mined for blast-furnace use in only 29 States of the Union, though it occurs in almost every State and Territory. For convenience in description, it is advisable to group the producing States in four natural districts defined by geographic and trade considerations:

1. The Lake Superior district, including Michigan, Minnesota, and Wisconsin.
2. The southern district, including Alabama, Georgia, North Carolina, Tennessee, the Virginias, Maryland, Kentucky, Arkansas, Missouri, and Texas.
3. The northern district, including New England, New York, New Jersey, Pennsylvania, Ohio, and Iowa.
4. The western district, including the producing States of Colorado, Utah, Wyoming, New Mexico, California, Washington, Nevada, and Montana.

The present relative importance of these four districts as iron-ore producers is well brought out by the following table, which gives the output of each district in long tons for 1905, 1906, and 1907, and the percentage of the total output produced by each district in those years. It will be seen that the Lake Superior district is preeminently the greatest, producing approximately four-fifths of the total, as against one-eighth from the southern district, one-twentieth from the northern, and one-sixtieth from the western districts.

Iron-ore production of the four districts in 1905, 1906, and 1907.

	1905.		1906.		1907.	
	Quantity, in long tons.	Percentage of total.	Quantity, in long tons.	Percentage of total.	Quantity, in long tons.	Percentage of total.
Lake Superior	33,480,367	78.73	38,035,084	79.66	41,638,744	80.51
Southern	5,700,819	13.41	6,325,710	13.24	6,427,195	12.42
Northern	2,520,845	5.93	2,582,666	5.41	2,823,422	5.46
Western	824,102	1.93	806,268	1.69	831,258	1.61
Total	42,526,133	100.00	47,749,728	100.00	51,720,619	100.00

Inspection of these figures will show that the increase during 1907 was very unequally divided among the four districts. The average increase shown by the entire country was 8.32 per cent, as compared with the tonnage of iron ore produced in 1906. When comparisons are made by separate districts, it is found that the Lake Superior district shows an increase over 1906 of 9.5 per cent, and the northern or northeastern district an increase of 9.3 per cent; the southern district, however, shows an increase of only 1.6 per cent, and the western district one of 3.1 per cent.

LAKE SUPERIOR IRON-ORE DISTRICT.

The Lake Superior district, which for convenience is here assumed to be exactly coextensive with the States of Minnesota, Michigan, and Wisconsin, produced during 1907 iron ore to the amount of 41,638,744 tons, an increase of 3,603,660 tons, or 9.5 per cent, over its output in 1906. It produces over four-fifths of the entire output of iron ore in the United States. It has produced about this proportion of the total for some years past, and though its relative output may be diminished during 1908, the next period of prosperity in the iron trade will doubtless see heavily increased shipments from the Lake district.

Lake Superior iron ore ranges.—The bulk of the production of the Lake Superior district is from five distinct areas or "ranges"—the Marquette, located in Michigan, the Menominee and the Gogebic in Michigan and Wisconsin, and the Vermilion and the Mesabi, located in Minnesota. In addition to the output from these five, relatively small shipments are made from the Baraboo range and from the Iron Ridge mine, both located in southern Wisconsin some distance from the main Lake ranges. The Baraboo ore deposits are closely similar to those of the other ranges, but the Iron Ridge mine works an isolated deposit of Clinton ore of the same type as that used at Birmingham, Ala. It may further be noted that iron-ore deposits similar to those of these ranges are worked to a relatively small extent on the Canadian side of the boundary, and that some of these Canadian ores enter the American market.

The essential facts concerning the five principal ranges, together with less important areas in Canada or elsewhere in the Lake Superior district, are embodied in tabular form as follows:

Lake Superior iron-ore ranges.

Range.	Location.	Opened.	Production 1889-1907, in long tons.
Marquette	Michigan	1854	58,259,251
Menominee	Michigan and Wisconsin	1872	55,087,592
Gogebic	do	1884	51,142,040
Vermilion	Minnesota	1884	25,789,037
Mesabi	do	1892	150,758,647
Michipicoten	Canada	1900	[a] 1,090,939
Baraboo	Wisconsin	1903	
Sudbury	Canada	1906	

[a] Production of 1906 and 1907 not included.

Production of iron ore in the Lake Superior district, by ranges.—Details concerning the production of the five principal ranges are presented in the following tables. It will be seen that in 1907 the Mesabi range produced almost two-thirds of the entire Lake Superior output, and considerably over half the entire production of the United States. The Menominee and Marquette ranges each produced considerably more ore than the State of Alabama, which ranks next to Minnesota and Michigan as an ore producer; and even the least productive range—the Vermilion—produced more ore than the State of New York, which follows Alabama as a producer. As a further comparison, it might be added that prior to 1900 the entire United States never produced in one year as much ore as did the Mesabi range alone in 1907.

Production of iron ore in the Lake Superior region in 1906–7, by ranges.

Range.	1906.	1907.	Increase (+) or decrease (−) in 1907.	Percentage of increase or decrease, 1907.	Percentage of total production in Lake Superior region.
	Long tons.	*Long tons.*	*Long tons.*		
Marquette (Michigan)	4,070,914	4,167,810	+ 96,896	+ 2.38	10.04
Menominee (Michigan and Wisconsin)	4,962,357	4,779,592	− 182,765	− 3.68	11.51
Gogebic (Michigan and Wisconsin)	3,484,023	3,609,519	+ 125,496	+ 3.60	8.69
Vermilion (Minnesota)	1,794,186	1,724,217	− 69,969	− 3.90	4.15
Mesabi (Minnesota)	23,564,891	27,245,441	+3,680,550	+15.62	65.61
Total	37,876,371	41,526,579	+3,650,208	+ 9.64	100.00

Production of Lake Superior iron ore, 1889–1907, by ranges, in long tons.

Year.	Marquette.	Menominee.	Gogebic.	Vermilion.	Mesabi.	Total.
1889	2,631,026	1,876,157	2,147,923	864,508	....	7,519,614
1890	2,863,848	2,274,192	2,914,081	891,910	....	8,944,031
1891	2,778,482	1,856,124	2,041,754	945,105	....	7,621,465
1892	2,848,552	2,402,195	3,058,176	1,226,220	29,245	9,564,388
1893	2,064,827	1,563,049	1,466,815	815,735	684,194	6,594,620
1894	1,935,379	1,255,255	1,523,451	1,055,229	1,913,234	7,682,548
1895	1,982,080	1,794,970	2,625,475	1,027,103	2,839,350	10,268,978
1896	2,418,846	1,763,235	2,100,398	1,200,907	3,082,973	10,566,359
1897	2,673,785	1,767,220	2,163,088	1,381,278	4,220,151	12,205,522
1898	2,987,930	2,275,664	2,552,205	1,125,538	4,837,971	13,779,308
1899	3,634,596	3,281,422	2,725,648	1,643,984	6,517,305	17,802,955
1900	3,945,068	3,680,738	3,104,033	1,675,949	8,158,450	20,564,238
1901	3,597,089	3,697,408	3,041,869	1,805,996	9,303,541	21,445,903
1902	3,734,712	4,421,250	3,683,792	2,057,532	13,080,118	26,977,404
1903	3,686,214	4,093,320	3,422,341	1,918,584	13,452,812	26,573,271
1904	2,465,448	2,871,130	2,132,898	1,056,430	11,672,405	20,198,311
1905	3,772,645	4,472,630	3,344,551	1,578,626	20,156,566	33,325,018
1906	4,070,914	4,962,357	3,484,023	1,794,186	23,564,891	37,876,371
1907	4,167,810	4,779,592	3,609,519	1,724,217	27,245,441	41,526,579
Total	58,259,251	55,087,908	51,142,040	25,789,037	150,758,647	341,036,883

Shipments and receipts of Lake Superior iron ore.—During 1907 42,245,070 long tons of iron ore were shipped from the Lake Superior district. Of this total, about 1,000,000 tons were shipped by rail, the remainder being lake shipments. Details concerning the shipments and receipts of these ores are given in the following tables, which are taken from the Iron Trade Review:

Shipments of Lake Superior iron ore, 1902–1907, in long tons.[a]

Shipping port.	1902.	1903.	1904.	1905.	1906.	1907.
Two Harbors	5,605,185	5,120,656	4,566,542	7,779,850	8,180,125	8,188,906
Escanaba	5,413,704	4,277,561	3,644,267	5,307,938	5,851,050	5,761,988
Duluth	5,598,408	5,356,473	4,649,611	8,807,559	11,220,218	13,445,977
Ashland	3,553,919	2,823,119	2,288,400	3,485,344	3,388,106	3,437,672
Marquette	2,595,010	2,007,346	1,907,301	2,977,828	2,791,033	3,013,826
Superior	4,180,568	3,978,579	4,169,990	5,118,385	6,083,057	7,440,386
Gladstone	92,375	85,816	553	....	....	....
Total	27,039,169	23,649,550	21,226,664	33,476,904	37,513,589	41,288,755
All-rail shipments	531,952	640,328	596,175	876,552	1,009,850	956,315
Grand total	27,571,121	24,289,878	21,822,839	34,353,456	38,523,439	42,245,070

Iron-ore receipts at Lake Erie ports, 1902–1907, in long tons.[a]

Port.	1902.	1903.	1904.	1905.	1906.	1907.
Ashtabula, Ohio	4,796,805	4,242,160	3,639,250	6,373,779	6,833,352	7,521,859
Cleveland, Ohio	4,873,318	4,434,160	3,572,228	5,854,745	6,604,661	6,495,998
Conneaut, Ohio	4,300,301	3,903,937	4,083,655	5,327,552	5,432,370	5,875,937
Buffalo and Tonawanda, N.Y.	2,256,798	2,149,901	2,433,601	3,774,928	4,928,331	5,580,438
Erie, Pa	1,717,268	1,257,798	1,284,778	2,112,476	1,986,539	2,294,239
Fairport, Ohio	1,538,744	1,434,342	1,157,858	2,008,621	1,861,498	2,437,649
Toledo, Ohio	1,037,571	652,305	508,793	1,006,855	1,423,741	1,314,140
Lorain, Ohio	1,442,417	990,490	972,931	1,605,823	2,191,965	2,621,025
Huron, Ohio	520,646	486,106	231,364	825,278	778,453	971,430
Sandusky, Ohio	165,556	130,532	48,356	51,202	35,847	83,043
Total	22,649,424	19,681,731	17,932,814	28,941,259	32,076,757	35,195,758

[a] Iron Trade Review, February 6, 1908.

Stocks of iron ore at Lake Erie ports.—The two following tables, taken also from the Iron Trade Review, contain data as to the stock of iron ore on hand at Lake Erie ports on December 1, 1907, and May 1, 1908. For comparison, the figures for similar dates of the five preceding years are also given.

On examination of these tables it will be seen that the stock on hand at lower lake ports on December 1, 1907, was about 1,000,000 tons greater than the average stock at that date for the five preceding years. The full effect of the business depression, however, is brought out in the table giving the stock on hand May 1, 1908. This table shows that the stock on hand at that date was about double the average tonnage on hand on the same day of the five years preceding.

The effect of this heavy tonnage in stock on May 1, 1908, and of the continued depression in the iron trade has been to delay markedly the commencement of 1908 shipments down the lakes, and to suggest great conservatism in plans as to total shipments during the remainder of the year. It seems certain that the Lake Superior iron-ore production and shipments during 1908 will show a heavy decrease as compared with those of 1907.

Stock of iron ore at lower lake ports, December 1, 1902–1907, in long tons.

Port.	At close of navigation, December 1—					
	1902.	1903.	1904.	1905.	1906.	1907.
Ashtabula, Ohio	1,967,136	1,911,911	1,403,575	1,589,951	1,631,312	2,056,820
Cleveland, Ohio	1,500,604	1,337,750	1,237,033	1,330,619	1,224,606	1,281,335
Fairport, Ohio	924,236	845,946	660,420	759,961	590,783	523,981
Erie, Pa	722,966	657,409	583,439	564,961	552,631	652,219
Lorain, Ohio	328,304	288,581	299,504	271,695	336,321	366,271
Conneaut, Ohio	673,679	591,364	684,487	976,976	1,057,424	1,090,774
Toledo, Ohio	310,023	106,710	318,573	368,024	281,000	518,645
Huron, Ohio	232,764	253,249	182,495	208,023	245,499	415,730
Buffalo, N. Y	319,367	282,890	318,739	315,780	315,412	435,407
Sandusky, Ohio	95,175	95,275	75,134	52,977	17,467	44,546
Total	7,074,254	6,371,085	5,763,399	6,438,967	6,252,455	7,385,728

Stock of iron ore at lower lake ports, May 1, 1903–1908, in long tons.

Port.	At opening of navigation, May 1—					
	1903.	1904.	1905.	1906.	1907.	1908.
Ashtabula, Ohio	1,073,967	1,559,028	623,451	462,564	568,485	1,799,454
Cleveland, Ohio	829,347	968,508	513,559	350,382	447,573	1,029,198
Fairport, Ohio	555,709	579,677	390,869	266,162	154,246	225,328
Erie, Pa	426,744	474,275	236,414	169,488	189,276	595,660
Lorain, Ohio	190,311	237,404	165,586	140,452	176,300	327,052
Conneaut, Ohio	125,400	128,018	96,295	148,528	139,853	462,392
Toledo, Ohio	126,331	160,216	71,642	52,550	147,397	217,788
Huron, Ohio	147,817	208,008	68,100	80,738	98,106	392,731
Buffalo, N. Y	60,241	150,106	61,271	90,906	50,313	388,441
Sandusky, Ohio	56,500	68,863	44,444	29,320	5,439	42,256
Total	3,592,367	4,534,103	2,271,631	1,791,090	1,976,988	5,480,300

Prices of Lake Superior iron ores, 1906–7.—The prices established in the fall of 1906 for 1907 deliveries of Lake Superior iron ores at lower lake ports showed an increase of 75 cents per ton on Bessemer ores and 50 cents on non-Bessemers. Along with this increase in price, however, was a decrease of over 1 per cent in the iron content of the basis ore, the Bessemer base being reduced from 56.7 per cent to 55 per cent, and the non-Bessemer from 52.8 per cent to 51.5 per cent. This reduction in iron content amounted to a further increase in price, so that the actual rise was about 92 cents per ton for Bessemer ores and 63 cents per ton for non-Bessemers. A comparison of prices for the four principal types in 1906 and 1907 is therefore as follows:

Prices per long ton of Lake Superior iron ores at lower lake ports, 1906–7.

	1906.	1907.	
		New basis.	Reduced to 1906 basis.
Old Range:			
Bessemer	$4.25	$5.00	$5.17
Non-Bessemer	3.70	4.20	4.33
Mesabi:			
Bessemer	4.00	4.75	4.92
Non-Bessemer	3.50	4.00	4.13

As no final action has been taken with regard to reduction of the official price list for the season of 1908, the prices quoted for the season of 1907 still stand as nominal quotations for 1908.

Grade and character of Lake Superior iron ores.—The bulk of the Lake Superior iron ore is red hematite, though small quantities of magnetite are furnished by the Marquette Range. In places this hematite carries a considerable percentage of combined water, so that a small portion of the output might fairly be placed in the brown hematite class. In the present report, however, all of the Lake Superior ores are grouped as red hematites.

The cargo analyses of these ores, as shipped in 1907, will be found in the following table, published by the Lake Superior Iron Ore Association:

Average cargo analyses of Lake Superior iron ores of the season 1907.

[The upper line of figures opposite each ore represents its analysis when dried at 212° F.; the lower line, when in its natural condition.]

GOGEBIC RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Ashland	58.70	0.049	8.90	0.250	2.88	0.300	0.210	0.010	2.70	....
	52.00	.0434	7.88	.221	2.55	.266	.186	.0088	2.39	11.42
Atlantic	62.0975	.0451	6.2057	.2510	....	....	....	....	....	....
	54.0309	.0392	5.3996	.2184	....	....	....	....	....	12.9902
Aurora	62.1826	.0343	4.8225	.4210	....	....	....	....	....	....
	54.6642	.0302	4.2394	.3701	....	....	....	....	....	12.0908
Bonnie	50.25	.053	13.00	5.97	1.42	.30	.46	.011	4.32	....
	45.56	.048	11.79	5.41	1.29	.27	.42	.010	3.92	9.34
Brotherton	56.724	.0223	14.70	.43	1.17	.34	.36	.027	1.00	....
	52.258	.0205	13.5428	.3961	1.0778	.3132	.3316	.0248	.9212	7.872
Castile	59.82	.26	8.62	1.65	.33	.95	.28	.016	1.40	....
	50.8649	.2211	7.3296	1.4030	.2806	.8078	.2381	.0136	1.1904	14.97
Cary Bessemer	54.57	.054	11.45	2.43	1.18	.27	.36	.011	5.24	....
	49.11	.0486	10.305	2.187	1.062	.243	.324	.0099	4.716	10.00
Cary Empire	53.85	.057	11.53	3.53	1.14	.21	.22	.013	4.93	....
	49.00	.05187	10.4923	3.2123	1.0374	.1911	.2002	.01183	4.4863	9.00
Cary, manganese	53.31	.054	11.29	4.18	1.09	.21	.24	.011	5.09	....
	47.98	.0486	10.161	3.762	.981	.189	.216	.0099	4.581	10.00
Earl	52.8065	.025	21.62	.41	.84	.12	.13	.032	1.57	....
	48.1216	.0227	19.7019	.3736	.7654	.1093	.1184	.0291	1.4307	8.8718
Eureka	62.29	.064	6.05	.82	1.35	.52	.34	.023	1.43	....
	52.1616	.0536	5.0663	.6867	1.1305	.4354	.2847	.0193	1.1975	16.26
Globe	59.50	.085	8.13	.240	2.85	.400	.360	.012	2.58	....
	53.03	.076	7.25	.214	2.54	.356	.321	.0107	2.30	10.88
Glyuna	64.03	.074	4.54	.39	.70	.60	.22	.020	1.95	....
	56.0839	.0648	3.9766	.3416	.6131	.5255	.1927	.0175	1.708	12.41
Hadley	62.98	.265	6.20	.26	.72	.90	.24	.023	1.03	....
	54.7422	.2303	5.3890	.2260	.6258	7823	.2086	.0200	.8953	13.08
Hildreth	[a]55.00	.088	[a]13.40	.45	2.91	.44	.84	.012	2.98	....
	47.85	.0763	11.658	.3915	2.5317	.3828	.7308	.01044	2.5926	13.00
Iron Belt Bessemer	55.50	.051	13.65	.270	2.51	.300	.110	.010	2.35	....
	48.37	.0444	11.90	.235	2.19	.261	.0959	.0087	2.05	12.84
King	55.512	.0759	16.21	.20	1.40	.34	.26	.008	2.12	....
	49.733	.0679	14.5227	.1791	1.2542	.3046	.2329	.0071	1.8993	10.409
Lawrence	62.46	.055	4.48	.43	1.19	.16	.16	.010	3.96	....
	55.7518	.0491	3.9988	.3838	1.0622	.1428	.1428	.0089	3.5347	10.74
Melrose	61.00	.047	5.90	.39	2.56	.30	.245	.010	3.32	....
	53.98	.042	5.22	.35	2.27	.26	.217	.009	2.94	11.51
Mikado	[a]58.00	.140	[a]11.91	.50	.72	.75	.40	.007	2.32	....
	50.46	.1218	10.3617	.435	.6264	.6525	.348	.00609	2.02	13.00
Montreal	63.27	.046	4.28	.33	1.21	.17	.29	.012	3.62	....
	56.8165	.0413	3.8434	.2963	1.0866	.1527	.2604	.0108	3.2508	10.20
Montrose	61.00	.076	6.16	.65	1.15	.32	.35	.010	4.37	....
	54.29	.068	5.48	.58	1.02	.28	.31	.009	3.89	11.00
New Era	56.05	.049	12.75	.53	2.42	.27	.245	.013	3.20	....
	50.50	.044	11.49	.48	2.18	.24	.221	.012	2.88	9.91
Newport	52.58	.051	7.24	8.70	1.21	.03	.17	.019	4.45	....
	47.35	.046	6.52	7.83	1.09	.027	.15	.017	4.01	9.95
Nimikon[a]	60.00	.080	7.65	59	1.42	.34	.32	.011	3.59	....
	54.00	.072	6.885	.531	1.278	.306	.288	.0099	3.231	10.00
Norbert	61.6457	.0662	6.4200	.7500	....	....	....	....	....	....
	53.4108	.0574	5.5624	.6498	....	....	....	....	....	13.3584
Norden	61.8605	.0713	4.6293	.7611	....	....	....	....	....	....
	54.2593	.0625	4.0605	.6676	....	....	....	....	....	12.2876
Norrie	62.4482	.0352	4.8281	.3950	....	....	....	....	....	....
	55.1221	.0311	4.2617	.3487	....	....	....	....	....	11.7315

[a] Expected analysis for the season of 1908.

Average cargo analyses of Lake Superior iron ores of the season 1907—Continued.

GOGEBIC RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Ottawa	55.67	0.051	9.00	3.21	1.11	0.25	0.46	0.014	5.71	....
	50.0028	.0458	8.0838	2.8832	.9970	.2240	.4132	.0126	5.1287	10.18
Ottawa, manganese *a*	53.59	.050	6.65	6.56	1.51	.20	.35	.010	5.60	....
	48.4990	.0453	6.0183	5.9368	1.3666	.1810	.3168	.0091	5.0680	9.50
Pike	55.10	.086	10.76	.42	.96	2.98	2.19	.010	3.60	....
	51.79	.08084	10.1144	.3948	.9024	2.8012	2.0586	.0094	3.384	6.00
Rand	61.3098	.0425	3.6432	2.7117	....	....	....	....	....	....
	54.1754	.0376	3.2193	2.3962	....	....	....	....	....	11.6366
Sunday Lake	58.124	.0216	14.62	.31	.88	.16	.11	.008	.92	....
	53.493	.0198	13.4553	.2853	.8098	.1472	.1012	.0073	.8467	7.966
Tilden	62.7341	.0509	4.2056	.7124	....	....	....	....	....	....
	54.9747	.0446	3.6854	.6243	....	....	....	....	....	12.3687
Vaughn	60.7643	.0343	5.9770	.3374	....	....	....	....	....	....
	53.4431	.0302	5.2569	.2967	....	....	....	....	....	12.0485
Walton	51.408	.028	23.43	.34	.98	.18	.29	.016	.99	....
	46.8659	.0255	21.3598	.3099	.8934	.1640	.2643	.0145	.9025	8.8353
Windsor	*a*60.00	.053	*a*7.65	.59	1.42	.34	.32	.011	3.59	....
	54.00	.0477	6.885	.531	1.278	.306	.288	.0099	3.231	10.00
Yale	61.98	.040	4.80	.45	.45	1.15	.61	.013	3.94	....
	54.4556	.0351	4.2173	.3954	.3954	1.0104	.5359	.0114	3.4617	12.14
BARABOO RANGE.										
Illinois *a*	53.47	0.043	18.51	0.22	....	....	....	....	....	....
	47.40	.038	16.41	.19	....	....	....	....	....	11.36
MARQUETTE RANGE.										
Abbotsford	62.2799	0.0412	7.3779	....	....	....	....	....	....	....
	60.5912	.0401	7.1778	....	....	....	....	....	....	2.7115
Abbotsford, lump	67.1500	.0190	2.0500	....	....	....	....	....	....	....
	66.6464	.0189	2.0346	....	....	....	....	....	....	.7500
Alford	62.8650	.0305	7.5736	....	....	....	....	....	....	....
	56.8449	.0276	6.8483	....	....	....	....	....	....	9.5763
American, lump	64.00	.048	4.29	0.10	2.42	0.46	0.28	0.060	0.75	....
	62.72	.047	4.20	.10	2.37	.45	.27	.059	.73	2.00
American, crushed	60.40	.053	9.44	.09	2.42	.46	.28	.076	.75	....
	58.63	.051	9.16	.09	2.35	.45	.27	.074	.73	2.93
Angeline, hematite	64.36	.046	3.96	....	....	....	....	....	....	....
	57.6858	.04123	3.5493	....	....	....	....	....	....	10.37
Angeline, south	63.05	.100	4.67	....	....	....	....	....	....	....
	56.0704	.0889	4.1530	....	....	....	....	....	....	11.07
Averhart	59.5905	.0569	8.8562	....	....	....	....	....	....	....
	55.0156	.0525	8.1763	....	....	....	....	....	....	7.6773
Austin No. 3	58.00	.059	12.95	.430	.620	.800	.290	.011	1.20	....
	48.97	.050	10.93	.363	.523	.675	.245	.0093	1.01	15.57
Bedford	57.9611	.1379	9.5294	....	....	....	....	....	....	....
	50.6300	.1205	8.3241	....	....	....	....	....	....	12.6483
Beresford, lump	62.3305	.1048	5.7501	....	....	....	....	....	....	....
	61.7106	.1038	5.6929	....	....	....	....	....	....	.9945
Beresford, crushed	61.9475	.1119	6.1452	....	....	....	....	....	....	....
	61.3084	.1107	6.0818	....	....	....	....	....	....	1.0316
Bernhart	57.6303	.0646	10.8432	....	....	....	....	....	....	....
	53.0806	.0595	9.9872	....	....	....	....	....	....	7.8946
Buffalo	60.3801	.1189	5.8192	....	....	....	....	....	....	....
	52.0508	.1025	5.0165	....	....	....	....	....	....	13.7947
Cambria	58.00	.084	8.78	.21	2.94	.92	.64	.010	3.35	....
	51.67	.075	7.82	.19	2.62	.82	.57	.009	2.98	10.92
Cambridge	58.40	.655	7.50	.790	1.02	2.10	.420	.013	1.63	....
	50.19	.563	6.45	.679	.877	1.80	.361	.0112	1.40	14.05
Cameo	57.5956	.1178	8.3256	....	....	....	....	....	....	....
	49.6609	.1016	7.1786	....	....	....	....	....	....	13.7765
Castleford	55.0410	.0930	15.1619	....	....	....	....	....	....	....
	53.7317	.0908	14.8012	....	....	....	....	....	....	2.3787
Castleford Bessemer	51.90	.050	20.85	.150	2.13	.150	.130	.016	1.10	....
	49.21	.0474	19.77	.142	2.02	.142	.123	.0152	1.04	5.19
Castleguard	54.0760	.0476	18.9374	....	....	....	....	....	....	....
	52.4080	.0461	18.3533	....	....	....	....	....	....	3.0846
Champion No. 1, lump	62.1698	.0564	6.0672	....	....	....	....	....	....	....
	61.8391	.0561	6.0349	....	....	....	....	....	....	.5320
Champion No. 1, crushed	64.0003	.0497	4.7808	....	....	....	....	....	....	....
	63.5264	.0493	4.7454	....	....	....	....	....	....	.7405

a Expected analysis for the season of 1908.

Average cargo analyses of Lake Superior iron ores of the season 1907—Continued.

MARQUETTE RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Charlotte[a]	55.00	0.100	13.82	0.20	3.60	0.38	0.52	0.026	2.32	....
	48.40	.088	12.16	.18	3.17	.33	.46	.023	2.04	12.00
Chatford	50.00	.170	21.50	.500	1.25	.643	.389	.028	3.96	....
	45.00	.153	19.35	.450	1.12	.579	.350	.025	3.56	10.00
Cliffs shaft, crushed	59.40	.106	6.85	.380	2.66	1.11	.870	.018	1.40	....
	58.64	.105	6.76	.375	2.63	1.10	.859	.0177	1.38	1.28
Cliffs shaft, lump	60.00	.106	6.15	.400	2.51	1.03	.770	.020	1.35	....
	59.57	.105	6.11	.397	2.49	1.02	.764	.0198	1.34	.72
Clinton	58.70	.263	8.90	.280	2.88	.700	.170	.013	1.82	....
	49.71	.223	7.54	.237	2.44	.593	.144	.011	1.54	15.31
Empire	43.05	.069	34.86	.14	.84	.41	.54	.014	1.50	....
	40.3723	.0647	32.6917	.1313	.7878	.3845	.5064	.0131	1.4067	6.22
Hematite, high grade	60.4034	.0724	6.9707	....	....	....	....	....	....	....
	53.3033	.0639	6.1513	....			....		....	11.7545
Hematite, sec. 16	54.2853	.1021	16.3645	....	....	....	....	....	....	....
	48.4928	.0912	14.6183	....		....	....		....	10.6705
Imperial	51.70	.253	11.30	.22	.98	1.53	1.92	.017	7.75	....
	45.50	.22264	9.944	.1936	.8624	1.3464	1.6896	.01496	6.82	12.00
Jackson Bessemer	50.30	.042	24.50	.100	2.00	.350	.080	.015	1.00	....
	49.37	.0412	24.05	.098	1.96	.344	.0785	.0147	.98	1.85
Jackson, south	43.90	.080	27.40	2.72	1.55	.300	.110	.017	2.90	....
	40.21	.0733	25.10	2.49	1.42	.275	.101	.0156	2.66	8.40
Lake	59.00	.092	7.00	.620	2.77	.550	.670	.012	3.20	....
	51.48	.0803	6.11	.541	2.42	.480	.585	.0105	2.79	12.75
Lake Bessemer	60.80	.046	8.50	.350	1.51	.480	.200	.010	1.25	....
	53.51	.0405	7.48	.308	1.33	.422	.176	.0088	1.10	11.99
Lake silica	45.00	.060	31.25	.280	1.05	.200	.280	.009	2.00	....
	40.41	.0539	28.06	.251	.94	.180	.251	.008	1.80	10.20
Lillie	58.53	.102	9.03	.35	2.00	.37	.15	.011	4.32	....
	51.01	.089	7.87	.30	1.74	.32	.13	.010	3.76	12.84
Mary[a]	58.00	.093	9.58	.19	2.98	.38	.52	.024	2.42	....
	51.04	.082	8.43	.17	2.622	.33	.46	.021	2.13	12.00
Negaunee	58.00	.076	9.80	.180	2.72	.960	.180	.012	2.55	....
	51.32	.0672	8.67	.159	2.41	.849	.159	.0106	2.26	11.52
Negaunee Bessemer	58.80	.062	8.85	.240	2.84	.910	.110	.010	2.25	....
	52.44	.0553	7.89	.214	2.53	.812	.098	.0089	2.01	10.81
Norfolk	52.1570	.0514	20.9357	....	....	....	....	....	....	....
	51.8332	.0511	20.8057	....	....	....	....	....	....	.6208
Norwalk	55.6121	.0967	11.3364	....	....	....	....	....	....	....
	55.2425	.0961	11.2611	....	....	....	....	....	....	.6646
Princeton	57.70	.205	11.20	.630	1.06	1.25	.570	.014	1.45	....
	49.84	.177	9.67	.544	.915	1.08	.492	.012	1.25	13.63
Republic, crushed	61.55	.044	8.15	.12	1.37	.76	.56	.035	.35	....
	60.78	.043	8.05	.118	1.35	.75	.55	.0345	.345	1.25
Republic, basic lump	66.95	.052	1.98	.03	1.41	.35	.18	.048	.21	....
	66.467	.0516	1.965	.0297	1.399	.347	.178	.0476	.208	.72
Richmond	42.25	.036	35.25	.12	.96	.35	.14	.005	2.00	....
	40.46	.034	33.76	.11	.92	.34	.13	.0047	1.92	4.23
Rolling mill	60.07	.094	6.16	....	....	....	....	....	....	....
	51.6962	.0809	5.3013	....		....	....	....	....	13.94
Rose	59.00	.258	7.70	.349	2.24	.82	.10	.013	3.62	....
	51.72	.226	6.75	.306	1.96	.72	.09	.011	3.17	12.34
Salisbury	58.60	.120	8.85	.530	2.30	.860	.460	.011	2.34	....
	50.98	.104	7.70	.461	2.00	.748	.400	.0096	2.04	13.01
Sheffield	67.09	.020	2.10	....	....	....	....	....	....	....
	63.6415	.0189	1.9920	....	....	....	....	....	....	5.14
Tilden silica	41.70	.045	37.10	.370	.69	.300	.130	.010	1.20	....
	41.14	.0444	36.60	.365	.68	.296	.128	.0098	1.18	1.34
Volunteer	54.4594	.0979	13.8426	....	....	....	....	....	....	....
	54.1718	.0974	13.7695	....	....	....	....	....	....	.5281

MENOMINEE RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Ajax	51.4742	0.0596	15.4004	0.4724	....	....	....	....	....	....
	48.3694	.0560	14.4715	.4439						6.0318
Algoma	54.10	.033	13.36	.15	1.53	2.46	1.41	0.037	3.13	....
	50.1561	.0305	12.3860	.1390	1.4184	2.2806	1.3072	.0343	2.9018	7.29
Baltic	56.38	.515	6.20	.24	3.11	1.50	1.58	.038	5.61	....
	50.74	.4635	5.58	.216	2.799	1.35	1.422	.0342	5.049	10.00
Barton	57.0105	.5146	5.9489	.2323	....	....	....	....	....	....
	53.1385	.4796	5.5449	.2165	....	....	....	....	....	6.7917
Berkshire[a]	58.10	.622	4.28	.25	3.27	3.06	1.82	.015	1.50	....
	51.1280	.5474	3.7664	.2200	2.8776	2.6928	1.6016	.0132	1.3200	12.00
Beta[a]	54.00	.332	12.72	.11	1.80	.28	.16	.050	7.09	....
	49.25	.30278	11.6006	.10032	1.6416	.25536	.14592	.0456	6.4661	8.80

[a] Expected analysis for the season of 1908.

Average cargo analyses of Lake Superior iron ores of the season 1907—Continued.

MENOMINEE RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Bristol	55.10	0.545	6.70	0.54	2.54	2.72	1.83	0.054	5.82	......
	50.4826	.4993	6.1385	.4947	2.3271	2.4921	1.6766	.0495	5.3323	8.38
Cadiz	50.9570	.0567	18.5523	.1504	......	......	......	......	......	......
	47.8725	0533	17.4293	.1413	......	......	......	......	......	6.0532
Calumet	42.82	.028	32.27	.20	2.53	.74	1.06	.011	1.86	......
	40.68	.0266	30.6565	.19	2.4035	.703	1.007	.01045	1.767	5.00
Chapin	58.9838	.0647	6.6059	.3481	......	......	......	......	......	......
	55.2924	.0607	6.1925	.3263	......	......	......	......	......	6.2583
Chatham	56.48	.277	7.70	.15	2.34	.59	.64	.084	6.58	......
	53.1533	.2607	7.2465	.1412	2.2022	.5552	.6023	.0791	6.1924	5.89
Clearfield	58.6496	.1031	5.6206	.2026	......	......	......	......	......	......
	51.5960	.0907	4.9446	.1784	......	......	......	......	......	12.0267
Clifford	39.89	.014	40.09	.16	.80	.51	.14	.021	1.12	......
	39.0284	.0137	39.2241	.1565	.7827	.4990	.1370	.0205	1.0958	2.16
Davy	37.0855	.020	43.00	.04	.36	.99	1.17	.023	1.50	......
	36.7503	.0198	42.6113	.0396	.3567	.9810	1.1594	.0227	1.4864	.9038
Dober, lump	58.0943	.5102	4.6155	.2420	......	......	......	......	......	......
	56.4940	.4961	4.4884	.2353	......	......	......	......	......	2.7547
Florence	54.50	.320	6.72	.26	3.35	1.51	2.46	.132	5.20	......
	48.58	.285	5.99	.23	2.99	1.35	2.19	.118	4.63	10.86
Gamma[a]	50.25	.319	19.29	.10	1.87	.34	.16	.066	5.51	......
	45.98	.29188	17.6503	.0915	1.711	.3111	.1464	.06039	5.0416	8.50
Granada	58.8161	.0616	8.7195	.1555	......	......	......	......	......	......
	54.5289	.0571	8.0839	.1442	......	......	......	......	......	7.2892
Groveland[a]	52.50	.040	11.22	1.10	2.49	3.51	4.62	.008	5.29	......
	50.3737	.03838	10.7655	1.0554	2.3891	3.3678	4.4328	.0076	4.9657	4.05
Hemlock	52.30	.201	6.47	.52	2.67	4.24	4.09	.016	6.64	......
	50.73	.19497	6.2759	.5044	2.5899	4.1128	3.9673	.01552	6.4408	3.00
Hollister[a]	56.00	1.00	10.00	.98	1.04	2.95	.30	.030	1.11	......
	48.72	.87	8.70	.85	.90	2.57	.26	.026	.97	13.00
James[a]	57.00	.425	6.24	.19	.80	.33	.16	.011	9.66	......
	51.30	.3825	5.616	.171	.72	.297	.144	.0099	8.694	10.00
Manganate	51.80	.618	5.75	2.44	3.76	2.25	2.40	.036	8.60	......
	47.1017	.5619	5.2285	2.2187	3.4190	2.0459	2.1823	.0327	7.8200	9.07
Manganate, No. 2	49.15	.604	6.38	5.00	2.63	2.10	2.37	.041	10.40	......
	45.6014	.5604	5.9194	4.6390	2.4401	1.9484	2.1989	.0380	9.6491	7.22
Michigan, No. 1	56.8365	.2438	6.6656	.2662	......	......	......	......	......	......
	51.9233	.2227	6.0894	.2432	......	......	......	......	......	8.6445
Michigan, No. 2	53.4024	.1830	7.4108	.3130	......	......	......	......	......	......
	49.9979	.1713	6.9383	.2930	......	......	......	......	......	6.3752
Pewabic	62.57	.017	6.80	.16	1.04	.60	1.27	.009	1.00	......
	......	......	......	......	......	......	......	......	......	......
Pewabic Genoa	39.02	.011	39.60	.09	1.41	.54	1.28	.011	1.05	......
	......	......	......	......	......	......	......	......	......	......
Russell	54.30	.051	11.44	.24	2.73	1.28	3.13	.019	3.11	......
	50.00	.047	10.53	.22	2.51	1.18	2.88	.017	2.86	7.92
Saginaw	52.90	.027	17.72	.09	2.41	.38	1.78	.015	1.39	......
	49.59	.025	16.61	.08	2.26	.36	1.67	.014	1.30	6.25
Toledo	46.25	.010	29.03	.11	1.38	.64	1.52	.006	1.24	......
	......	......	......	......	......	......	......	......	......	......
Toms	47.00	.022	......	......	......	......	......	......	......	......
	45.1670	.02114	......	......	......	......	......	......	......	3.90
Vivian	[a]39.00	.016	[a]38.45	.06	1.32	1.18	1.32	.008	1.91	......
	37.83	.01552	37.2965	.0582	1.2804	1.1446	1.2804	.00776	1.8527	3.00
Walpole	58.02	.084	9.10	.15	1.21	1.58	2.42	.013	2.34	......
	53.96	.07812	8.463	.1395	1.1253	1.4694	2.2506	.01209	2.1762	7.00
Waucedah[a]	39.00	.016	41.53	.03	.89	.35	.80	.027	.60	......
	37.83	.01552	40.284	.0291	.8633	.3395	.776	.02619	.582	3.00
Youngs[a]	57.00	.400	6.90	.30	2.75	.50	.79	.086	......	......
	52.7250	.3700	6.382	.2775	2.5437	.4625	.7307	.07955	......	7.50

MESABI RANGE.

Adriatic	57.66	0.075	9.31	0.23	1.76	0.37	0.23	0.010	5.47	......
	50.70	.06595	8.1863	.20224	1.5476	.3253	.2022	.00879	4.8098	12.07
Agnew	61.32	.050	5.07	.70	......	......	......	......	......	......
	52.78	.043	4.36	.60	......	......	......	......	......	13.93
Albany	57.18	.082	7.32	.95	2.43	.27	.24	.012	6.55	......
	49.75	.07134	6.3684	.8265	2.114	.2349	.2088	.01044	5.6985	13.00
Alberta[a]	58.78	.045	9.36	1.20	1.36	.10	.16	.028	3.80	......
	52.90	.0405	8.424	1.08	1.224	.09	.144	.0252	3.42	10.00
Alexander	58.12	.032	......	......	......	......	......	......	......	......
	51.33	.028	......	......	......	......	......	......	......	11.68
Athens	59.86	.050	6.65	.35	1.86	.27	.34	.012	4.74	......
	52.87	.04416	5.8739	.3091	1.6429	.23849	.3003	.0106	4.1868	11.67

[a] Expected analysis for the season of 1908.

Average cargo analyses of Lake Superior iron ores of the season 1907—Continued.

MESABI RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Athol[a]	57.50	0.065	......	......	......	......	......	......	......	......
	50.60	.0572	......	......	......	......	......	......	......	12.00
Bangor[a]	57.00	.064	10.72	0.45	1.46	0.29	0.07	0.007	5.23	......
	50.73	.05696	9.5408	.4005	1.2994	.258	.0623	.00623	4.6547	11.00
Beaver	62.27	.096	2.55	.40	1.68	.21	.16	.011	5.72	......
	54.50	.084	2.23	.35	1.47	.18	.14	.010	5.01	12.48
Bessemer	57.17	.031	......	......	......	......	......	......	......	......
	52.31	.028	......	......	......	......	......	......	......	8.50
Biwabik	61.5401	.0449	4.74	......	......	......	......	......	......	......
	55.5867	.0405	4.2814	......	......	......	......	......	......	9.6739
Brunt[a]	56.00	.046	8.00	.65	3.12	.40	.55	.015	......	......
	48.1600	.0395	6.8800	.5590	2.6832	.3440	.4730	.0129	......	14.00
Cass	57.099	.0343	11.00	.45	1.63	.29	.12	.012	4.76	......
	51.6066	.0310	9.9419	.4067	1.4732	.2621	.1084	.0108	4.3021	9.619
Corsica	55.87	.051	10.42	.86	1.63	.22	.20	.008	6.38	......
	48.89	.0446	9.1175	.7525	1.4262	.1925	.175	.007	5.582	12.50
Crete	57.71	.058	7.47	.86	1.50	.21	.23	.011	6.86	......
	50.78	.05104	6.5736	.7568	1.32	.1848	.2024	.00[illegible]68	6.0368	12.00
Crosby	57.50	.026	13.25	.300	1.24	.250	.150	.016	1.80	......
	52.64	.0238	12.13	.275	1.14	.229	.137	.0146	1.65	8.45
Croxton	57.00	.073	8.84	.40	2.28	.27	.26	.012	6.17	......
	51.3000	.0657	7.9560	.3600	2.0520	.2430	.2340	.0108	5.5530	10.00
Cyprus	59.72	.069	5.94	.34	2.11	.24	.30	.012	5.60	......
	52.75	.06095	5.2468	.3003	1.8638	.212	.265	.0106	4.9465	11.67
Detroit	59.86	.056	7.09	.77	2.05	.21	.29	.009	3.35	......
	53.60	.050	6.35	.69	1.84	.19	.26	.008	3.00	10.45
Douglas	58.96	.036	9.55	......	......	......	......	......	......	......
	53.8246	.0328	8.7182	......	......	......	......	......	......	8.71
Duluth	60.1648	.0575	4.6563	.3913	......	......	......	......	......	......
	53.5726	.0512	4.1461	.3484	......	......	......	......	......	10.9569
Elba	59.50	.039	7.51	.82	.86	.27	.23	.010	5.09	......
	54.74	.03588	6.9092	.7544	.7912	.2484	.2116	.0092	4.6828	8.00
Franklin	56.65	.032	......	......	......	......	......	......	......	......
	51.83	.029	......	......	......	......	......	......	......	8.50
Fowler	55.90	.048	12.12	......	......	......	......	......	......	......
	49.2703	.0423	10.6826	......	......	......	......	......	......	11.86
Group, No. 1	61.4415	.0370	4.5969	.5340	......	......	......	......	......	......
	54.2688	.0327	4.0603	.4717	......	......	......	......	......	11.6741
Group, No. 2	61.3737	.0511	4.5025	.5817	......	......	......	......	......	......
	54.3298	.0452	3.9857	.5149	......	......	......	......	......	11.4770
Group, No. 3	58.0510	.0891	5.9073	1.0526	......	......	......	......	......	......
	50.1285	.0769	5.1011	.9089	......	......	......	......	......	13.6474
Group, No. 4	57.5837	.0675	6.0550	.7154	......	......	......	......	......	......
	48.8299	.0572	5.1345	.6066	......	......	......	......	......	15.2018
Hawkins	55.40	.047	13.30	.29	......	......	......	......	......	......
	47.99	.041	11.52	.25	......	......	......	......	......	13.38
Hector	[a]56.00	.072	[a]10.27	.42	1.48	.21	.23	.008	7.03	......
	48.72	.06264	8.9349	.3654	1.2876	.1827	.2001	.00696	6.1161	13.00
Higgins	58.3761	.0328	11.3179	.8513	1.5882	......	......	......	......	......
	53.0133	.0298	10.2782	.7731	1.4423	......	......	......	......	9.1866
Hobart[a]	59.00	.082	8.10	1.06	1.50	.22	.14	.010	......	......
	53.1000	.0738	7.2900	.9540	1.3500	.1980	.1260	.0090	......	10.00
Holland	57.2229	.035	......	......	......	......	......	......	......	......
	51.6887	.0316	......	......	......	......	......	......	......	9.6713
Jayanel	61.34	.050	3.23	......	......	......	......	......	......	......
	53.4517	.0436	2.8146	......	......	......	......	......	......	12.86
Jennings	57.55	.065	10.93	.63	1.68	.31	.37	.019	3.48	......
	50.07	.05655	9.5091	.5481	1.4616	.2697	.3219	.01653	3.0276	13.00
Kellogg[a]	58.50	.035	9.70	.90	.85	.16	.19	.015	3.38	......
	52.65	.031	8.73	.81	.76	.14	.17	.013	3.04	10.00
Kinney	58.00	.079	5.69	1.25	2.50	.30	.32	.049	6.68	......
	50.30	.068	4.93	1.08	2.17	.26	.28	.042	5.79	13.27
LaBelle	58.73	.038	9.88	.63	1.06	.88	.46	......	3.27	......
	53.09	.034	8.92	.56	.95	.80	.41	......	2.97	9.59
Larkin, manganiferous	47.80	.027	22.98	2.50	1.86	.27	.31	.063	2.64	......
	43.21	.024	20.77	2.26	1.68	.24	.28	.057	2.39	9.61
LaRue	55.445	.044	14.71	.40	1.70	.36	.17	.012	2.85	......
	50.205	.0398	13.3199	.3622	1.5393	.3259	.1539	.0108	2.5806	9.450
Laura	57.95	.076	6.00	1.10	2.27	.22	.38	.016	6.50	......
	50.09	.066	5.18	.95	1.96	.19	.33	.014	5.62	13.57
Leetonia	60.72	.055	2.80	......	......	......	......	......	......	......
	52.7718	.0478	2.4335	......	......	......	......	......	......	13.09
Leonard	58.75	......	......	......	......	......	......	......	......	......
	49.585	......	......	......	......	......	......	......	......	15.60
Lincoln	62.61	.025	6.30	......	......	......	......	......	......	......
	57.9330	.02313	5.8294	......	......	......	......	......	......	7.47

[a] Expected analysis for the season of 1908.

Average cargo analyses of Lake Superior iron ores of the season 1907—Continued.

MESABI RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Mahoning	64.98	0.049	1.00	0.43	1.30	0.11	0.12	0.008	3.70	
	57.89	.044	.89	.38	1.16	.10	.11	.007	3.30	10.91
Malta	56.97	.021	13.74	.26	.56	.17	.28	.011	3.46	
	51.84	.01911	12.5034	.2366	.5096	.1547	.2548	.010	3.1486	9.00
Mariska[a]	56.75	.054								
	51.36	.049								9.50
Mayas Bessemer	56.73	.046								
	50.2571	.0407								11.41
Mayas, manganese	52.19	.048		4.94						
	46.1255	.0424		4.3659						11.62
Midway[a]	56.62	.064	10.09	2.33	.83	.10	.13	.011	4.60	
	52.66	.05952	9.3837	2.1669	.7719	.093	.1209	.01023	4.278	7.00
Miller	59.64	.084	4.81	.80	1.90				6.69	
	53.63	.076	4.32	.72	1.70				6.01	10.07
Minorca	57.66	.026	12.47	.56	.89	.23	.25	.008	3.02	
	53.34	.02405	11.5347	.518	.8232	.21275	.23125	.0074	2.7935	7.50
Morrow	58.125	.055	9.00	.33	1.77	.45	.43	.017	4.60	
	52.276	.0494	8.0944	.2967	1.5919	.4047	.3867	.0152	4.1371	10.062
Mohawk[a]	58.00	.076	7.04	.84	1.94	.27	.31	.009	6.21	
	50.46	.06612	6.1248	.7308	1.6878	.2349	.2697	.00783	5.4027	13.00
Nassau[a]	57.50	.087	8.61	.85	1.80	.25	.15	.010	5.90	
	51.7500	.0783	7.7490	.7650	1.620	.2250	.1350	.0090	5.3100	10.00
Onandaga[a]	54.00	.030								
	49.68	.028								8.00
Pearce	59.72	.048	8.00	.66	1.92	.15	.24	.009	2.81	
	53.28	.043	7.14	.59	1.71	.13	.21	.008	2.51	10.78
Pettit	57.09	.057								
	48.53	.048								15.00
Republic Beaver	62.27	.065	2.55	.40	1.68	.21	.16	.011	5.72	
	54.50	.0568	2.23	.35	1.47	.18	.14	.010	5.01	12.48
Shenango[a]	61.00	.045	5.80	.87	2.55	.15	.11	.018	4.27	
	53.29	.040	5 162	.7743	2.2695	.1335	.0979	.016	3.80	11.00
Shilling	58.30	.091	5.92	.56	2.06	.21	.28	.013	7.21	
	50.5525	.0789	5.1332	.4855	1.7862	.1820	.2427	.0112	6.2518	13.289
Spring	55.00[a]	.033	[a]16.45	.46	1.11	.24	.26	.013	2.63	
	49.50	.0297	14.805	.414	.999	.216	.234	.0117	2.367	10.00
Susquehanna	57.41	.071	8.70	.59	4.11	.81	.36	.017		
	50.5208	.0625	7.6560	.5192	3.6168	.7128	.3168	0150		12.00
Syracuse[a]										
										12.00
Troy	54.00[a]	.042	[a]11.66	.94	2.62	.36	.73	.146	6.01	
	46.44	.03612	10.0276	.8084	2.2532	.3096	.6278	.12556	5.1686	14.00
Union	61.26	.035								
	56.94	.033								7.05
Utica Bessemer	62.28	.043	4.34	.41	1.53	.24	.26	.012	4.21	
	55.43	.03827	3.8626	.3649	1.3617	.2136	.2314	.01068	3.7469	11.00
Victoria	60.22	.059								
	54.78	.054								9.04
Vermont	62.5903	.0806	3.6381	.5162	2.7039					
	56.4690	.0727	3.2823	.4657	2.4395					9.7799
Virginia	63.0632	.0597	3.7388	.3810						
	56.5933	.0536	3.3552	.3419						10.2594
Wacotah	56.52	.065	6.28	1.05					6.32	
	48.89	.056	5.43	.91					5.46	13.50
Webb[a]	56.00	.034	19.10	.40	1.23	.27	.13	.012	3.22	
	49.28	.0211	16.808	.352	1.0824	.2376	.1144	.0105	2.8336	12.00
Wilpen[a]	60.00	.070	6.35	1.36	3.40	.23	.14	.015	5.10	
	52.80	.0616	5.588	1.1968	2.992	.20	.1232	.0132	4.488	12.00
Yates	58.60	.054	9.46	.44	2.22	.59	.27	.012	2.85	
	51.28	.047	8.28	.39	1.94	.52	.24	.011	2.49	12.50
Yawkey	53.92	.105	11.07	.78	3.62	.31	.32	.009	6.33	
	46.3712	.0903	9.5202	.6708	3.1132	.2666	.2752	.0077	5.4438	14.00

VERMILION RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Chandler	62.8150	0.0412	6.6891	0.1044						
	59.4269	.0390	6.3283	.0988						5.3937
Jura	63.0149	.0644	4.6667	.0914						
	59.0786	.0604	4.3752	.0857						6.2466
Pioneer	63.5751	.0351	5.1432	.1058						
	60.0602	.0332	4.8588	.1000						5.5288
Savoy	64.2657	.0399	4.4185	.0979						
	60.6368	.0376	4.1690	.0924						5.6467
Vermilion, lump	65.6110	.1166	3.9242	.0795						
	64.9080	.1154	3.8822	.0786						1.0714

[a] Expected analysis for the season of 1908.

Average cargo analyses of Lake Superior iron ores of the season 1907—Continued.

CANADIAN ORES.

MICHIPICOTEN DISTRICT.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Helen	58.20 54.88	0.127 0.120	4.40 4.15	0.165 0.156	0.88 0.83	0.23 0.22	0.14 0.13	0.127 0.120	10.40 9.81	.... 5.70
SUDBURY DISTRICT.										
Moose Mountain [a]	55.50 54.0570	0.10 0.0974	12.79 12.4575	0.02 0.0195	1.21 1.1785	3.60 3.5064	3.15 3.0681	0.011 0.0107	0.20 0.1948	.... 2.60

[a] Expected analysis for the season of 1908.

PUBLICATIONS ON THE LAKE SUPERIOR IRON-ORE DISTRICT.

The following list gives the titles of the various reports issued by the United States Geological Survey, which cover the geology and iron resources of this region:

BAYLEY, W. S. The Menominee iron-bearing district of Michigan: Mono. U. S. Geol. Survey, vol. 42, 1904.

CLEMENTS, J. M. The Vermilion iron-bearing district of Minnesota: Mono. U. S. Geol. Survey, vol. 45, 1903.

CLEMENTS, J. M., SMYTH, H. L., BAYLEY, W. S., and VAN HISE, C. R. The Crystal Falls iron-bearing district of Michigan: Mono. U. S. Geol. Survey, vol. 36, 1899.

IRVING, R. D., and VAN HISE, C. R. The Penokee iron-bearing series of Michigan and Wisconsin: Mono. U. S. Geol. Survey, vol. 19, 1892.

LEITH, C. K. The Mesabi iron-bearing district of Minnesota: Mono. U. S. Geol. Survey, vol. 43, 1903.

VAN HISE, C. R. The iron-ore deposits of the Lake Superior region: Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 3, 1901, pp. 305–434.

VAN HISE, C. R., BAYLEY, W. S., and SMYTH, H. L. The Marquette iron-bearing district of Michigan, with Atlas: Mono. U. S. Geol. Survey, vol. 28, 1897

SOUTHERN DISTRICT.

Status of the district as an ore producer.—During 1907 the southern district produced 6,427,195 tons of iron ore, an increase of only 102,085 tons, equivalent to 1.6 per cent, over its output in 1906. During the last thirty years of its history the southern iron district has always displayed this apparent paradox—that its best showing is made during periods of general trade depression, whereas in prosperous times it fails to advance equally with the Lake Superior and northern districts. The causes of this phenomenon have been previously discussed in detail,[a] and it is unnecessary to dwell on them here.

Red-ore reserves of Alabama.—In 1905 field work was commenced by the United States Geological Survey on the red or Clinton ores of Alabama, the red ores of the northern portion of the State being examined by the writer. In 1906 a more detailed study of the iron ores of the Birmingham district was undertaken, the work being in charge of the writer, with the assistance of E. F. Burchard. This work has now been completed, and a final report on the Birmingham district is in preparation for publication by the Survey.

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[a] Mineral Resources U. S. for 1906, U. S. Geol. Survey, 1907, pp. 98–100.

Before the detailed work was completed the geologist under whose direction it was carried out published in Mineral Resources for 1906 a preliminary statement concerning the amount of the ore reserves of the State. During the current year Mr. Burchard has published[a] a much more detailed estimate, covering the ore reserves in the larger portion of the Birmingham district. This estimate places the reserves at about 340,000,000 tons, and as allowances have been made for every possible disturbing factor, it seems to the writer that this total may be regarded as considerably under the actual unworked tonnage in this portion of the State.

So little deep drilling has been done back from the outcrop, even in the immediate vicinity of Birmingham, that little of the red-ore field can be considered adequately developed, at least so far as the question of reserve tonnage is concerned. The matter has not heretofore been pressing, however, as the annual ore production of the State is small, compared to its possibilities, and has shown a very low rate of increase. The question will become of immediate practical importance whenever the next era of active furnace construction sets in.

Gray hematites of eastern Alabama.—Considerable attention has been attracted during the last three years to the deposits of hematite in Talladega and adjoining counties in eastern Alabama. These ore deposits have been known for many years, but it is only recently that they have been actively prospected and developed. The following summary of the character and relationships of these ores is based on recent work by the writer.

The gray hematites, formerly erroneously considered as magnetites, occur chiefly in Talladega County, Ala., though undeveloped deposits of apparently similar ore have been described from adjoining areas in Alabama and Georgia. The ore deposits are associated with a series of schists, slates, and marbles, whose exact geologic age is still uncertain, though they are either pre-Cambrian or a highly metamorphosed phase of the Cambrian. Structurally, all these rocks are compressed into a series of close folds, trending northeast and southwest and usually showing only southeasterly dips. Small faults are common, but in the immediate vicinity of the iron-ore deposits no large faults have been noted, complex folding being the most prominent feature.

The ores occur as bedlike deposits in the slates, and have apparently originated by replacement of a porous and possibly calcareous sandstone or shale. Considering their assumed mode of origin, these deposits are astonishingly persistent along the strike, single ore bodies having been traced for a distance of more than 4 miles without break. The ore bodies vary rapidly in thickness along the strike, the minimum of workable ore noted at any point in the range being 3 feet and the maximum 18 feet.

No deep drilling has been done along the range, so that it is impossible to say to what depth these ores extend. Actual mining has been carried on to a depth of 350 feet, the ore still maintaining its thickness and grade. In view of this fact, and of the remarkable persistence of the ore bodies along the strike, it seems probable that they can be safely expected to remain workable at depths of 1,000 or 1,500 feet. Assuming the latter depth, and using the known thicknesses of the ore beds at various points, it is estimated that the quantity of these gray hematites in Talladega County is about 60,000,000 tons. Of this total somewhat more than half will grade 45 per cent or over in metallic iron, and a relatively small tonnage will grade as high as 55 per cent. The other half of the total will range from 35 to 45 per cent metallic iron.

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[a] Burchard, E. F., An estimate of the tonnage of available Clinton iron ore in the Birmingham district, Alabama: Bull. U. S. Geol. Survey No. 340, 1908.

Analyses of a number of samples follow:

Analyses of gray hematite iron ores, Alabama.

	1.	2.	3.
Metallic iron	52.90	48.11	44.03
Manganese oxide	....	.67	.21
Titanic oxide	....	.26	.17
Silica	17.88	20.78	28.95
Alumina	3.59	4.46	3.97
Lime	....	1.09	.78
Magnesia	....	.57	.45
Potash	....	.94	1.39
Soda	....		.45
Phosphorus	.278	.266	.293
Sulphur	....	.031	.007

Of these analyses No. 1 represents the average of a set of samples from one of the highest-grade deposits of the district; No. 2 is the average of a long series of published analyses from various properties, and No. 3 is a composite sample covering a number of prospect openings and various grades of ore. Nos. 1 and 3 were collected by the writer and were analyzed by the Lehigh Valley Testing Laboratory. So far as shipping grade is concerned, such ore as is represented by analysis No. 2 is probably about the average for the district. It will be seen that this is about the grade of a good brown ore as to iron, and that it is somewhat higher in silica and lower in alumina than the better brown ores. It is, however, far superior in both iron and silica percentages to the well-known and long-used brown ores of the Oriskany district of Virginia.

The iron ores of Texas.—Deposits of magnetite and red hematite, apparently of good quality but of unknown extent, have long been known to exist in Llano and adjoining counties of Texas. These deposits will be studied during 1908 by the United States Geological Survey, and their importance will, it is hoped, be determined.

Another series of ores, however, is better known and of greater present importance. These are the brown ores which occur abundantly in a group of counties in northeastern Texas. The brown ores in question, according to Kennedy's report, occur in at least 19 counties—Cass, Morris, Marion, Upshur, Wood, Harrison, Gregg, Panola, Smith, Van Zandt, Rusk, Cherokee, Henderson, Anderson, Houston, Nacogdoches, Shelby, Sabine, and San Augustine. To this list should be added Camp County, which contains at least one workable deposit of ore, as well as a number of counties farther south than those named. In the counties named ore districts aggregating 1,000 square miles were located by the Texas Geological Survey.

During an examination of the district made for the United States Geological Survey by the writer several years ago a number of these deposits were visited and studied. The ores are associated with Eocene clays and greensands. They usually overlie clays, and have apparently been formed by surface waters carrying down iron in solution either from the greensands or from overlying beds. The ore beds range in thickness from a few feet up to the maximum recorded thickness, 25 feet.

The average of 131 analyses of these Texas brown ores, on samples collected by Kennedy for the Texas Survey, gives the following results:

Average analysis of brown ores, Texas.

Iron oxide	66.39
Silica	14.47
Alumina	8.17
Sulphur	.083
Phosphorus	.172
Metallic iron	46.63
Phosphorus in 100 parts iron	.371

Recent developments in the Virginias.—Several years ago a brief report was published by the United States Geological Survey dealing with the characteristic series of brown-ore deposits which are associated with the Oriskany formation in the Virginias. These ores have been long known and worked, and are the basis of supply for furnaces at Covington, Lowmoor, Iron Gate, Glen Wilton, Longdale, and Goshen. Since the publication of the report mentioned, and more particularly within the last two years, important developments have taken place with regard to this series of ore deposits. Areas supposed to be ore bearing have proved worthless, and, on the other hand, careful development has revealed the existence of heavy tonnages in regions hitherto unworked. Unfortunately, little can be published in the present statistical report concerning the more important of these developments, but it is hoped that in the immediate future operations will be so far advanced that the Survey will be permitted to present a summary of the results.

Among the less important but still interesting features of 1907 has been the extension in this region of active development southward and southeastward from the old district. Shipments have been made, for example, from an area along North Mountain, north of Gala station, which had previously been known only as a possible future source of ore. The developments in this area are still slight, but the ores, as shown by the following analyses, are well up to the average grade of the district:

Analyses of Oriskany iron ores from Virginia.

	1.	2.	3.	4.	5.
Metallic iron	46.10	43.80	42.80	43.00	43.30
Manganese	.25	.25	.36	.62	.28
Phosphorus	.639	.630	.643	.70	.652
Insoluble	20.80	23.80	26.10	24.90	23.20
Alumina	1.88	....	1.25	....	2.00

The above analyses are of carload shipments as received at the furnace, and are all calculated on a dry basis.

PUBLICATIONS ON SOUTHERN IRON ORES.

Burchard, E. F. The iron ores of the Brookwood district, Alabama: Bull. U. S. Geol. Survey No. 260, 1905, pp. 321–334.

——— The Clinton or red ores of the Birmingham district, Alabama: Bull. U. S. Geol. Survey No. 315, 1907, pp. 130–151.

Burchard, E. F. The brown iron ores of the Russellville district, Alabama: Bull. U. S. Geol. Survey No. 315, 1907, pp. 152–160.

——— Available tonnage of Clinton ore in the Birmingham district, Alabama: Bull. U. S. Geol. Survey No. 340, 1908.

Eckel, E. C. Iron ores of northeastern Texas: Bull. U. S. Geol. Survey No. 260 1905, pp. 348–353.

——— The iron industry of Texas: Iron Age, vol. 76, 1905, pp. 478–479.

——— The Clinton or red ores of northern Alabama: Bull. U. S. Geol. Survey No. 285, 1906, pp. 172–179.

——— The Oriskany and Clinton iron ores of Virginia: Bull. U. S. Geol. Survey No. 285, 1906, pp. 183–189.

Grasty, J. S. The gray ores of Alabama: Manufacturers' Record, vol. 50, 1906, pp. 550–553.

Hayes, C. W., and Eckel, E. C. Iron ores of the Cartersville district, Georgia: Bull. U. S. Geol. Survey No. 213, 1903, pp. 233–242.

Holden, R. J. The brown ores of the New River-Cripple Creek district, Virginia: Bull. U. S. Geol. Survey No. 285, 1906, pp. 190–193.

Keith, A. Iron-ore deposits of the Cranberry district, North Carolina-Tennessee: Bull. U. S. Geol. Survey No. 213, 1903, pp. 243–246.

Kindle, E. M. The iron ores of Bath County, Ky.: Bull. U. S. Geol. Survey No. 285, 1906, pp. 180–182.

McCallie, S. W. Preliminary report on the iron ores of Georgia: Bull. Georgia Geol. Survey No. 10, 1900, p. 190.

Nitze, H. B. C. Iron ores of North Carolina: Bull. North Carolina Geol. Survey No. 1, 1893, 239 pp.

Phalen, W. C. Iron ores near Ellijay, Georgia: Bull. U. S. Geol. Survey No. 340-E, 1908.

Porter, J. J. The Virginia iron industry: Manufacturers' Record, vol. 51, 1907, pp. 717–719, 749–752, 788–790.

Smith, P. S. The gray iron ores of Talladega County, Ala.: Bull. U. S. Geol. Survey No. 315, 1907, pp. 161–184.

NORTHERN DISTRICT.

Status of the district as an ore producer.—During 1907 the northern iron-ore district produced 2,823,422 long tons of iron ore, as compared with a production of 2,582,666 tons in 1906, an increase of 9.3 per cent. This output, which amounted to 5.46 per cent of the total production of the United States, came from the States of New York, Pennsylvania, New Jersey, Ohio, Connecticut, and Massachusetts, in the order named.

The ore reserves of New York and New Jersey are known to be so large, in comparison with the demands which have heretofore been made on them, that it seems probable that these northeastern States, at least, will continue to show heavy increases in production whenever the ore market is satisfactory. It is probable that the magnetite district of southeastern Pennsylvania can furnish increased tonnage when required, and the possible productive status of the low-grade Clinton hematites of Pennsylvania has never been adequately determined.

Character of the Adirondack magnetites, New York.—An important and detailed report[a] recently published by the New York State Museum deals with the magnetite deposits of the Adirondack district of New York. The following extracts from this report cover certain features of general interest to the iron industry:

> The ores show great variation in their mineral and chemical composition. They range from impure lean varieties consisting of magnetite intermixed with the constituents of the wall rocks, such as quartz, feldspar, pyroxene, hornblende, etc., to those made up of practically pure magnetite. The richest average from 60 to 70 per

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[a] Newland, F. H., and Kemp, J. F., Geology of the Adirondack magnetic iron ores: Bull. New York State Mus. No. 119, 1908.

cent iron. They have been obtained principally from the Mineville district, where some large bodies have averaged 60 to 65 per cent iron and have afforded considerable quantities assaying above 65 per cent and even approaching closely the theoretical limit for magnetite which is 72.4 per cent. The Hammondville, Arnold Hill, and many other mines have yielded ores with 50 to 60 per cent iron. The magnetites that carry less than about 50 per cent iron are generally considered too refractory for direct smelting; their utilization depends upon concentration, to which they are as a rule very adaptable. There are large bodies of such ores in the Lyon Mountain Arnold Hill, and St. Lawrence County districts. The lowest grade of milling ore that is worked carries about 35 per cent iron.

According to the percentage of phosphorus present, the magnetites may be subdivided into low-phosphorus, Bessemer, and non-Bessemer grades. There is no well-defined connection between the distribution of phosphorus and the nature of the ore occurrence. In some districts, as instanced by Mineville, both Bessemer and high-phosphorus ores have been produced from contiguous deposits, though generally the ores from any one district show a fair degree of uniformity in respect to the phosphorus. The leaner magnetites are apt to be lower in phosphorus than those having a high percentage of iron. The bulk of the low-phosphorus ores has been produced at Lyon Mountain; the present concentrates from this locality carry less than 0.01 per cent of that element, with 65 per cent iron. The non-Bessemer ores range up to about 2 per cent phosphorus, corresponding to 10 per cent of apatite, which is the containing mineral. The Old Bed group of mines at Mineville has furnished most of this grade of ore.

The magnetites carry a variable proportion of sulphur, due to admixture with pyrite and more rarely pyrrhotite. The part played by these minerals in the composition depends upon the geological associates of the ore bodies, and a sharp line can be drawn generally between the class which carries any considerable proportion of them and the low-sulphur deposits. The presence of sulphur above a fraction of 1 per cent is confined mainly to the deposits that occur in the banded gneisses and schists of the Grenville series, which are themselves impregnated with pyrite. When the wall rock is an acid variety, corresponding to granite or syenite in mineral composition, sulphur exists only in minute quantity. Among the deposits of the former class it is possible to find gradations from ores with fairly low sulphur to those in which the magnetite is replaced largely or almost completely by pyritic minerals.

Mining and concentrating the Adirondack magnetites.—The report cited contains also data on mining and concentrating practice in the Adirondack iron district, which are summarized as follows:

Both underground and open-cut methods are used in the Adirondack mines, the latter, however, being restricted to a few large ore bodies or those so situated at to present a considerable surface development. In general the high inclination of the bodies and their narrowness across the strike render a system of underground working the most suitable from the start. Inclined shafts or slopes following the dip of the ore have been generally adopted in preference to vertical shafts, which, in some instances at least, would seem to offer important advantages as regards economy of operation. The deepest shafts are at Lyon Mountain, about 1,500 feet, measured on the incline. Horizontal drifts are extended on either side of the shaft at more or less regular intervals and the ore stoped out between them, leaving occasional pillars of ore for roof support. In the Old Bed workings at Mineville the ore is removed in large chambers, which are extended downward with the progress of operations, as the main mass of ore lies nearly vertical. The chambers are of great size, measuring 200 feet or more from roof to floor. Timbering or other artificial support is not required in the Adirondack mines, and little trouble has been experienced from caving. The workings are relatively dry, as the wall rocks are nearly impervious to water.

Concentration of the magnetites has been practiced since the early days of mining in the region. As early as 1836, according to local records, a plant was in operation at Palmer Hill for treating the ore by a magnetic process. * * * A wet gravity system of concentration was commonly used up to about fifteen years ago, when the magnetic process was perfected to an extent that made its introduction feasible. This process is now generally recognized to be well adapted to the Adirondack magnetites.

At present there are six concentrating plants in the region; two are installed at Mineville, two at Lyon Mountain, and one each at Arnold Hill and Benson Mines. Another plant is in course of erection at the Cheever mine, near Port Henry. In 1906 the mills at Mineville, Lyon Mountain, and Arnold Hill, which were the only ones operated, crushed 729,091 long tons of ore, making 479,644 long tons of concentrates.

The concentrates from the Adirondack mills carry on the average 60 to 65 per cent iron. Besides raising the iron content, magnetic concentration affords a partial elimination of the phosphorus and sulphur, important advantages for some ores. In fact, the treatment of the Old Bed ores at Mineville is designed particularly to reduce the phosphorus, and the concentration is rather incidental to that purpose.

The costs of mining and milling differ of course according to local conditions. With a modern plant 75 cents per ton is probably a fair average for underground mining under favorable circumstances. Quarry work has been conducted for less than half that amount at Benson Mines. Magnetic concentration costs from 25 to 40 cents per ton of material treated. For a period of ten months during 1900 the total cost of producing concentrates at Benson Mines, including mining, milling, and general expense, is said to have been $2 per ton, which is equivalent to about 80 cents per ton of the crude material handled.

PUBLICATIONS OF NORTHERN IRON ORES.

The following list contains titles of the more recent papers and reports on iron ores in the Northern and Eastern States:

Eckel, E. C. Limonite deposits of eastern New York and western New England: Bull. U. S. Geol. Survey No. 260, 1905, pp. 335–342.

——— The Clinton hematite (in New York): Eng. and Min. Jour., vol. 79, 1905, pp. 897–898.

Kemp, J. F. The titaniferous iron ores of the Adirondacks (N. Y.): Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1899, pp. 377–422.

Newland, D. H., and Kemp, J. F. Geology of the Adirondack magnetic iron ores (N. Y.): Bull. New York State Mus. No. 119, 1908.

Spencer, A. C. Magnetite deposits in Berks and Lebanon counties, Pa.: Bull. U. S. Geol. Survey No. 315, 1907, pp. 185–189.

Stewart, C. A. The magnetite belts of Putnam County, N. Y.: School of Mines Quart., April, 1908, pp. 283–294.

WESTERN DISTRICT.

Status of the district as a producer.—The western district during 1907 produced 831,258 tons of iron ore, as compared with a production of 806,268 tons in 1906, an increase of 3.1 per cent. As the total amounts to only 1.61 per cent of the entire domestic production, it is obvious that the western district is still an unimportant factor in the iron industry of the United States. It is improbable that it will always retain its present low rank. On the other hand, there is little possibility that it will ever become of predominant importance. Its supplies of good coking coals are limited, and its iron ores, though of good grade and widely distributed, do not seem to be present in such quantities as are known to exist in the Lake Superior, the southern, or the northern, districts.

PUBLICATIONS ON WESTERN IRON ORES.

The following list includes the more important recent publications relative to the iron ores of the western United States:

Ball, S. H. The Hartville iron-ore range, Wyoming: Bull. U. S. Geol. Survey No. 315, 1907, pp. 190–205.

——— Titaniferous iron ore of Iron Mountain, Wyoming: Bull. U. S. Geol. Survey No. 315, 1907, pp. 206–212.

Boutwell, J. M. Iron ores in the Uintah Mountains, Utah: Bull. U. S. Geol. Survey No. 225, 1904, pp. 221–228.

Diller, J. S. Iron ores of the Redding quadrangle, California: Bull. U. S. Geol. Survey No. 213, 1903, pp. 219–220.

Leith, C. K. Iron ores in southern Utah: Bull. U. S. Geol. Survey No. 225, 1904, pp. 229–237.

——— Iron ores of the western United States and British Columbia: Bull. U. S. Geol. Survey No. 285, 1906, pp. 194–200.

FOREIGN TRADE IN IRON ORE.

In the present section data are presented on the imports and exports of iron ore into and from the United States, with a table summarizing the latest available official reports on the world's production of iron ore. In view of their direct and increasingly important connection with the domestic iron industry, conditions in the iron-ore trade of Cuba are briefly discussed.

IMPORTS.

During 1907 the United States imported over 1,200,000 long tons of iron ore. Of this total, over half was from Cuba and about a third from Spain. About 116,000 tons came from British North America, and the remainder was from numerous smaller sources of supply. Among the year's changes in these smaller imports may be noted the appearance of Algiers and the cessation of shipments from Norway and British India.

The table following shows the imports, by countries, from 1904 to 1907, inclusive:

Quantity and value of iron ores imported into the United States, 1904–1907, by countries, in long tons.

Country.	1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Cuba	364,630	$822,413	539,935	$1,437,900	639,362	$2,178,997	657,133	$2,522,710
Spain	36,810	89,218	191,861	366,436	171,870	418,922	296,318	760,801
French Africa	....	....	....	....	....	....	65,940	252,897
Greece	2,500	2,535	....	....	48,630	61,560	23,800	42,927
Newfoundland and Labrador	5,400	5,400	5,600	5,600	[a]125,395	125,395	89,685	97,735
United Kingdom	173	2,093	408	2,396	231	1,955	5,765	16,491
Germany	2	70	1	42	1,084	8,949	273	2,096
Netherlands	1	10	....	....	50	474	500	3,673
Quebec, Ontario, etc.	77,887	177,966	104,096	240,303	57,890	100,125	26,878	51,328
Belgium	210	1,671	400	3,370	400	6,662	125	1,102
France	....	8	....	....	....	....	....	....
Norway	....	....	....	....	9,278	37,240	....	....
East Indies—British India	....	....	....	....	6,200	27,155	....	....
Other countries	....	....	3,350	6,114	....	....	62,751	185,723
Total	487,613	1,101,384	845,651	2,062,161	1,060,390	2,967,434	1,229,168	3,937,483

[a] Newfoundland only.

EXPORTS.

The iron ore exported by the United States during 1907 amounted to 278,208 long tons, a slight increase over the exports of 1906. The bulk of these exports represent Lake Superior ores shipped directly from the American side to Canadian furnaces.

Exports of iron ore, 1903–1907.

1903	long tons..	80,611	$255,728
1904	do....	213,865	458,823
1905	do....	208,017	530,457
1906	long tons..	265,240	$771,839
1907	do....	278,208	763,422

IRON-ORE INDUSTRY OF CUBA.

The increasing importance of Cuban ores to the American iron industry justifies a brief summary of the character and occurrence of these ores, with a list of further references to papers and reports dealing with the subject. The statistics of Cuban ore production have, as usual, been collected directly by this Survey from the producers.

Iron ores of Cuba.—Two types of iron ore occur in Cuba, distinct as to composition, origin, and location. The first type includes hematites, often with considerable associated magnetite, occurring as irregularly shaped deposits in marble or basic igneous rocks. Deposits of this type of ore have been worked for a number of years in the vicinity of Santiago. All the ore produced in Cuba up to the present time has been derived from deposits of this class. During 1907, however, a series of extensive brown-ore deposits attracted attention. They were first described by A. C. Spencer in 1901, but active exploitation was long delayed. These brown ores are extensively developed at many points on the island, but the three large areas now known are the Moa, Mayari, and Cubitas fields. The first two of these are located on the north shore of Cuba, in Oriente (Santiago) Province; the Cubitas field is a few miles north of Camaguey, in Camaguey Province.

Spencer estimates the tonnage of ore present in these three fields as aggregating somewhat over 1,500,000,000 tons. The following analyses give a fair idea of the range in composition of the workable grades of ore.

Analyses of brown iron ores from Cuba.

	1.	2.	3.
Metallic iron	46.03	52.00	54.69
Manganese	....	.364	.594
Chromium	1.73	Trace.	Trace
Titanium	....	.25	....
Phosphorus	.015	.0368	.018
Silica	5.50	2.62	2.51
Alumina	10.33	....	....

Of these analyses, No. 1 represents a composite sample from th Mayari field; Nos. 2 and 3 are selected analyses. It will be seen tha the characteristic feature of these Cuban brown ores, as compare with more familiar brown ores in the South, is the presence of chromium and the high percentage of alumina as compared to the silica. Both of these peculiarities are explained by the geologic history the Cuban ores.

Iron ore production of Cuba.—During the year 1907 the iron min of Cuba produced 681,393 long tons, as compared with an output 640,574 tons in 1906. The production for a series of years is given the following table:

Shipments of iron ore from mines in the province of Oriente (Santiago), 1902–1907, in long tons.

Year.	Juragua Iron Co. (Limited).	Spanish-American Iron Co.	Cuban Steel Ore Co.	Total.
1902	221,039	455,105	23,590	699,734
1903	155,898	467,723	....	623,621
1904	31,162	356,111	....	387,273
1905	139,828	421,331	....	561,159
1906	133,379	507,195	....	640,574
1907	181,063	500,330	....	681,393

PUBLICATIONS ON CUBAN IRON ORES.

The following list includes the more important papers and reports bearing on this subject:

Chisholm, F. F. Iron ore beds in the province of Santiago, Cuba: Proc. Colorado Sci. Soc., vol. 3, 1891, pp. 259–263.

Graham, T. H. Sigua iron mines, Cuba: Iron Age, vol. 41, 1888, p. 140.

Kimball, J. P. Geological relations and genesis of the specular iron ores of Santiago de Cuba: Am. Jour. Sci., 3d ser., vol. 28, 1884, pp. 416–429.

——— The iron-ore range of the Santiago district of Cuba: Trans. Am. Inst. Min. Eng., vol. 13, 1885, pp. 613–634.

Spencer, A. C. The iron ores of Santiago, Cuba: Eng. and Min. Jour., November 16, 1901, pp. 633–634.

——— Iron ores of Cuba: In Ann. Rept. Military Governor of Cuba for 1901.

——— Three deposits of iron ore in Cuba: Bull. U. S. Geol. Survey No. 340, 1908.

Anon. The Mayari iron-ore district of Cuba: Iron Age, vol. 80, August 15, 1907, pp. 421–426.

——— Iron mining in Cuba: Iron Age, vol. 81, April 9, 1908, pp. 1149–1157.

WORLD'S PRODUCTION OF IRON ORE.

Complete official figures covering the world's production of iron ore for 1906 are not yet available. The following table contains statistics covering the production of the most important sources of supply for both 1905 and 1906:

World's production of iron ore in 1905 and 1906, by countries.

Country.	1905.	1906.
	Tons.	*Tons.*
United States	42,526,133	47,749,728
Germany and Luxemburg	23,444,073	26,734,000
Great Britain	14,590,703	15,500,406
Spain	9,077,245	9,448,533
France	7,395,400	8,481,000
Russia	6,050,000	....
Sweden	4,365,967	4,503,000
Austria-Hungary	3,697,679	4,088,466
Canada, Newfoundland	963,543	951,752
Cuba	561,159	640,574
Algeria	568,609	780,000
Greece	465,622	680,620
Italy	366,616	405,000
Belgium	176,620	177,000
China	123,000	111,460
India	102,120	74,106
Japan	100,000	....
Norway	46,582	109,259
Australia	11,184	34,001
Portugal	3,200	....

Of the figures in this table, those for the United States, Great Britain, Cuba, Canada, and Australia are in long tons; for other countries in metric tons. The figures for the ore production of Russia, China, and Japan have been estimated from the known pig-iron outputs of those countries, and are therefore merely approximations.

IRON AND STEEL INDUSTRY OF THE UNITED STATES.

As noted in the introduction to this report, the data on pig-iron and steel production presented in the following tables are those collected and published by Mr. J. M. Swank, general manager of the American Iron and Steel Association.

PRODUCTION OF PIG IRON BY STATES.

During 1907 the production of pig iron in the United States amounted to 25,781,361 long tons, as compared with an output of 25,307,191 tons in 1906 and of 22,992,380 tons in 1905. The smallness of the increase shown by 1907 over 1906 is due to the falling off in demand and production during the last quarter of the year. If the output of the first half of the year had been maintained, 1907 would have shown a total production of about 27,000,000 tons.

In the following table the pig-iron production of the United States for 1907 is given by States. It will be noted that since 1905 no change has occurred in the relative rank of the six leading States. These are, named in order, Pennsylvania, Ohio, Illinois, Alabama, New York, and Virginia.

Production of pig iron, 1905–1907, by States.

	Blast furnaces.				Production, including spiegeleisen and ferromanganese, in long tons.		
	In blast June 30, 1907.	December 31, 1907.			1905.	1906.	1907.
		In.	Out.	Total.			
Pennsylvania	141	70	87	157	10,579,127	11,247,869	11,348,549
Ohio	58	17	51	68	4,586,110	5,327,133	5,250,687
Illinois	24	11	13	24	2,034,483	2,156,866	2,457,768
Alabama	34	15	34	49	1,604,062	1,674,848	1,686,674
New York	17	9	17	26	1,198,068	1,552,659	1,659,752
Virginia	16	7	19	26	510,210	483,525	478,771
Tennessee	14	9	12	21	372,692	426,874	393,106
Colorado	6	3	3	6	407,774	413,040	468,486
Missouri	2	1	1	2			
Maryland	4	1	4	5	332,096	386,709	411,833
New Jersey	8	5	6	11	311,039	379,390	373,189
Wisconsin	6	2	4	6	351,415	373,323	322,083
Minnesota	1	1	0	1			
Michigan	12	8	5	13	288,704	369,456	436,507
West Virginia	4	0	4	4	298,179	304,534	291,066
Kentucky	5	1	7	8	63,735	98,127	127,946
Georgia	2	1	3	4	38,699	92,599	55,825
Texas	1	0	4	4			
Connecticut	2	3	0	3	15,987	20,239	19,119
Massachusetts	2	2	0	2			
Indiana	0	1	0	1	....	....	(a)
Total	359	167	[b] 276	[b] 443	22,992,380	25,307,191	25,781,361

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[a] Tonnage included with Michigan.

[b] Including 1 idle stack each in Oregon and Washington.

PRODUCTION OF PIG IRON BY KINDS.

In the following table the pig-iron production for 1905, 1906, and 1907 is classified by kinds. It will be noted that the great increase in total pig-iron production of 1906 over 1905 was due entirely to an increase in the output of steel-making irons, for foundry irons showed an actual decrease in 1906. It might also be said that basic pig showed almost twice as much increase in 1906, proportionately, as did Bessemer and other acid pigs. The figures for 1907 show a continuation of one of these movements. Of the total increase of 474,170 tons over 1906, basic iron accounts for over two-thirds. Bessemer and low-phosphorus irons show an actual falling off in 1907 as compared with 1906. Foundry irons, however, show a relatively heavy increase.

Production of pig iron, 1905–1907, by kinds, in long tons.

Kind.	1905.	1906.	1907.
Bessemer	12,407,116	13,840,518	13,231,620
Lowphosphorus			
Basic	4,105,179	5,018,674	5,375,219
Forge and foundry	5,837,174	5,714,492	6,397,777
Charcoal	352,928	433,007	437,397
Spiegeleisen	227,797	244,980	283,430
Ferromanganese	62,186	55,520	55,918
Total	22,992,380	25,307,191	25,781,361

PRODUCTION OF STEEL.

BESSEMER STEEL.

The total production of Bessemer-steel ingots and castings in 1907 was 11,667,549 long tons, against 12,275,830 tons in 1906, a decrease of 608,281 tons. The following table gives the production of Bessemer-steel ingots and castings in the last seven years:

Production of Bessemer steel ingots and castings in 1901–1907.

1901	long tons	8,713,302	1905	long tons	10,941,375
1902	do	9,138,363	1906	do	12,275,830
1903	do	8,592,829	1907	do	11,667,549
1904	do	7,859,140			

Below is given, by States, the production of Bessemer ingots and castings since 1903:

Production of Bessemer ingots and castings, 1903–1907, by States, in long tons.

State.	1903.	1904.	1905.	1906.	1907.
Pennsylvania	3,909,436	3,464,650	4,491,445	4,827,725	4,351,841
Ohio	2,330,134	2,050,115	3,131,149	3,769,913	3,636,679
Illinois	1,366,569	1,257,190	1,651,250	1,684,772	1,723,073
Other States	986,690	1,087,185	1,667,531	1,993,420	1,955,956
Total	8,592,829	7,859,140	10,941,375	12,275,830	11,667,549

OPEN-HEARTH STEEL.

The total production of open-hearth steel ingots and direct castings in the United States in 1907 was 11,549,088 long tons, against 10,980,413 tons in 1906, an increase of 568,675 tons, or over 5.1 per cent. The following table gives the total production of open-hearth steel ingots and castings, by States, since 1903:

Production of open-hearth steel ingots and castings, 1903–1907, by States, in long tons.

State.	1903.	1904.	1905.	1906.	1907.
New England	169,209	195,901	239,282	251,047	239,797
New York and New Jersey	104,598	165,986	348,072	553,186	706,019
Pennsylvania	4,442,730	4,306,498	6,471,818	7,718,213	7,867,705
Illinois	422,919	358,215	617,625	884,472	1,013,251
Ohio	369,349	480,906	687,392	818,683	819,642
Other States	321,106	400,660	607,187	754,812	902,674
Total	5,829,911	5,908,166	8,971,376	10,980,413	11,549,088

The following table gives the production, by States, of basic and acid open-hearth steel ingots and castings in 1907:

Production of basic and acid open-hearth steel ingots and castings in 1907, by States, in long tons.

State.	Basic open-hearth steel.	Acid open-hearth steel.	Total.
New England	172,960	66,837	239,797
New York and New Jersey	665,474	40,545	706,019
Pennsylvania	6,826,479	1,041,226	7,867,705
Illinois	1,006,589	6,662	1,013,251
Ohio	758,401	61,241	819,642
Other States	849,412	53,262	902,674
Total	10,279,315	1,269,773	11,549,088

NOTE ON THE VALUE OF THE PRODUCTION OF PIG IRON IN THE UNITED STATES IN 1907.

By W. T. Thom.

Hitherto the United States Geological Survey has never collected independently the statistics of the production of pig iron in the United States, having relied for that information upon the admirable annual reports of Mr. James M. Swank, general manager of the American Iron and Steel Association. In January, 1908, however, in order to ascertain the value of the output, circular letters were sent to the producers of pig iron asking them to furnish the Survey with confidential information as to their stock on hand on December 31, 1906, their marketed production and their total receipts from sales free on board at furnace during 1907, and their stock on hand on December 31,1907. It is gratifying to be able to state that the managers of only three furnaces, rated at an annual average output of 35,000 tons each, have refused or failed to comply with this request, and that the total production reported to the Survey differs by only about four-tenths of 1 per cent from the total output reported by Mr. Swank, 25,781,361 long tons, which, as heretofore, is accepted as official.

As will be readily understood by all persons familiar with the conditions of the pig-iron industry, it has been found difficult to arrive at the value of the output. The aggregate of the various values reported by the producers to the Survey amounts to about $529,958,000, or an approximate average price of $20.56 per ton for the whole country. Costs of transportation are practically excluded from this sum, which, under the terms of the request for information, represents the value at first hand of the pig-iron output of 1907 to its producers. This should be borne in mind in considering the average price per ton for recent years.

The following table gives the quantity and value of pig iron produced in the United States in 1907, by States:

Quantity and value of pig iron produced in the United States in 1907, by States, in long tons.

	Quantity.	Value.
Alabama	1,686,674	$30,100,000
Illinois	2,457,768	52,229,000
New Jersey	373,189	7,554,000
New York	1,659,752	33,097,000
Ohio	5,250,687	106,387,000
Pennsylvania	11,348,549	234,952,000
Tennessee	393,106	7,542,000
Virginia	478,771	8,963,000
Colorado	468,486	11,628,000
Missouri		
Connecticut	19,119	663,000
Massachusetts		
Georgia	55,825	1,181,000
Texas		
Indiana	758,590	18,829,000
Michigan		
Minnesota		
Wisconsin		
Kentucky	830,845	16,833,000
Maryland		
West Virginia		
Total	25,781,361	529,958,000

Cordial thanks are due to the various firms for the trouble taken by them in making their reports.

MANGANESE ORES.

By E. C. Harder.

INTRODUCTION.

The manganese-mining industry in the United States is at present, as for several years past, very small. In 1907 less than twenty manganese mines were in operation, and not half that number operated steadily. Of the large manganese districts of the United States, namely, the Valley and the Piedmont districts of Virginia, the Cartersville and the Cave Springs districts of Georgia, and the Batesville district of Arkansas, only the first two produced manganese ore in 1907. For this lack of activity there are three reasons—(1) the discontinuous and scattered nature of the deposits, (2) the crude mining methods naturally resulting therefrom, and (3) the low prices paid, which prevent attractive profits to operators under these conditions. All of the ore mined has to be either washed or sorted, and often both. Single pockets as a rule are small and are soon exhausted, so that the erection of expensive concentrating plants is discouraged, except in cases like the Crimora basin in Virginia, which is not at all typical of known American manganese deposits. In short, under present conditions domestic manganese can not compete with the foreign high-grade product. The larger part of the ore mined in this country was used in the brick, paint, and chemical industries, about one-sixth (947 long tons, valued at $6,747) being used in the steel industry, as against the 209,032 long tons imported for this purpose. The main reason for this seems to be that, although the demand in the former industries is limited, the prices paid are higher and ores can be used which would be undesirable in steel manufacture. Besides, the mining is on such a small scale that the supply does not run far ahead of the demand in these industries.

USES.

The uses of manganese in the industries may be classified as follows: (1) Metallurgical, in the manufacture of alloys and in copper and silver reduction; (2) chemical, as an oxidizer and as a coloring material.

The manganese ores used in the manufacture of alloys are dependent in value on the percentage of metallic manganese present and on the absence of injurious substances like phosphorus and sulphur. The latter condition is especially true in the case of the alloys with iron. Spiegeleisen and ferromanganese are alloys of iron and manganese. The former contains below 20 per cent manganese, while the latter has a manganese content ranging from 20 per cent to 90 per cent, above which the alloy becomes unstable. Silicon and carbon are present in varying quantities. Spiegeleisen and ferromanganese are used in the manufacture of steel in the following ways—(a) as reducers of iron oxide in the final melting, in which case the manganese oxide formed goes into the slag; (b) as recarburizers of steel, in which case they contain considerable carbon; (c) for counteracting the effects of phosphorus and sulphur by the formation of manganese compounds with these elements; (d) in the manufacture of manganese steel, used for railroad and street-car rails on curves, for burglar-proof safes, for car wheels, and for other purposes. The addition of small quantities of manganese gives to steel hardness, ductility, and strength.

Manganese is also used to form alloys with copper, zinc, aluminum, tin, lead, magnesium, and silicon, and with combinations of these metals.

Manganese oxides are used to a slight extent in copper and silver reduction as a substitute for iron oxides.

As an oxidizer manganese oxide is used in the manufacture of chlorine, bromine, and oxygen, and of disinfectants like potassium permanganate; as a drier in paints and varnishes; as a decolorizer of glass, and in the Leclanche battery. In these cases the value of the ore depends on its available oxygen content—that is, on its percentage of pyrolusite or manganese peroxide.

As a coloring material manganese is used in calico dyeing; for coloring bricks, glass, and pottery, and in the manufacture of green and violet paints.

Compounds of manganese are used in a small way for medicine, and the mineral rhodonite, a silicate of manganese, is used rarely for ornamental purposes on account of its beautiful pink color.

PRICES.

The prices of manganese ores used in the steel industry vary from $5 to $15 per long ton, according to the grade of the ore. They are governed by the following schedule of prices established by the Carnegie Steel Company:

Schedule of prices paid per ton of 2,240 pounds for domestic manganese ore delivered at Pittsburg or Bessemer, Pa., and South Chicago, Ill.

Prices are based on ores containing not more than 8 per cent silica or 0.25 per cent phosphorus, and are subject to deductions as follows: For each 1 per cent in excess of 8 per cent silica there shall be deduction of 15 cents per ton; fractions in proportion.

For each 0.02 per cent, or fraction thereof, in excess of 0.25 per cent phosphorus there shall be a deduction of 2 cents per unit of manganese per ton.

Percentage of metallic manganese in ore.	Price per unit, in cents.	
	Manganese.	Iron.
Over 49	30	6
46 to 49	29	6
43 to 46	28	6
40 to 43	27	6

Ores containing less than 40 per cent manganese or more than 12 per cent silica or 0.27 per cent phosphorus are subject to acceptance or refusal at the buyer's option.

Settlements are based on analysis of sample dried at 212° F., the percentage of moisture in the sample as taken being deducted from the weight.

The manganese ores for oxidizing and coloring purposes are valued according to the quantity of manganese peroxide present, their consistency, etc., and prices range up to $25 per ton for the better grades of ore.

PRODUCTION.

The production of manganese in 1907, amounting to 5,604 long tons, exceeded that of any year since 1902 except 1906. Toward the close of 1902 there occurred a sudden drop in production due to the cessation of mining operations in northwestern Georgia, after which there was a steady increase from the 2,825 tons produced in 1903 to 6,921 tons in 1906.

The bulk of the production was, as usual, in Virginia. South Carolina joined the ranks of producers for the first time since 1903, and produced more ore than in any previous year. Tennessee also showed an increase and a fair promise of becoming something more than a mere intermittent producer. California produced more ore than in any year since 1902. On the other hand, Georgia and Arkansas, which contain some of the most important manganese deposits in the country, were not on the list of producers of manganese in 1907, although Arkansas produced considerable manganiferous iron ore. The Utah mines, which gave fair promise for several years, were again idle.

The following table shows the quantity, the value, and the average price per ton of the manganese ore produced in the different States in 1905, 1906, and 1907:

Production of manganese ores in the United States, 1905–1907, by States.

State.	1905.			1906.			1907.		
	Quantity, long tons.	Value.	Average price per ton.	Quantity, long tons.	Value.	Average price per ton.	Quantity, long tons.	Value.	Average price per ton.
Arkansas				62	$290	$4.68			
California	1	[a]$5	$5.00	1	20	20.00	100	$600	$6.00
Georgia	150	[a]900	6.00						
South Carolina							800	4,800	6.00
Tennessee	[a]20	[a]100	5.00	30	300	10.00	100	1,500	15.00
Utah				800	10,000	12.50			
Virginia	[b]3,947	35,209	8.92	6,028	77,522	12.86	4,604	56,469	12.27
Total	4,118	36,214	8.80	6,921	88,132	12.73	5,604	63,369	11.31

[a] Estimated.

[b] In addition, 453 tons of tailings, valued at $406, were shipped.

The following table shows the total production of manganese ore in the United States, by States, as compiled from previous volumes of Mineral Resources of the United States and from other sources. The statistics of production previous to 1880 are very indefinite, and only approximate figures, compiled by Penrose[a] from all available sources, could be obtained for this period. The total production previous to 1880 probably did not exceed 50,000 long tons. The table shows Arkansas, Georgia, and Virginia as the principal producers, California as a steady producer, but only of small quantities, and the other States as producing small quantities of ore intermittently.

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[a] Penrose, jr., A. F., Manganese: Ann. Rept. Arkansas Geol. Survey, vol. 1, 1890, p. 65.

Production of manganese ore in the United States, 1838–1907, in long tons.

Year.	Alabama.	Arkansas.	California.	Georgia.	Indian Territory, Michigan, Missouri, Montana, and Nevada.	North Carolina.
1838–1879		410				
1866–1879				19,950		
1867–1879			5,500			
1880				1,800		
1881		100		1,200		
1882		175		1,000		
1883		400				
1884		800				
1885		1,483	200	2,580	(Nev.) 200	
1886	75	3,316	100	6,041	(Nev.) 30	14
1887		5,651		9,024		14
1888		4,312	1,500	5,568	(Mich.) 100	
1889		2,528	53	5,208	(Nev.) 15	47
1890		5,339	386	749	(Nev.) 100	14
1891		1,650	705	3,575	(Ind. T.) 206	
1892		6,708		826		
1893		2,020	400	724		
1894		1,934	278	1,277		
1895		2,991	525	3,856		
1896		3,421	284	4,085		2
1897		3,240	484	3,332	(Mich.) 37	
1898	22	2,662	541	6,689		
1899		356	115	3,089	(Mo.) 16	90
1900		145	131	3,447	(Mont.) 37	
1901	17	91	610	4,074	(Mo.) 28	
1902		82	846	3,500		
1903			16	500		
1904			60			
1905			1	150		
1906		62	1			
1907			100			
Total	114	49,876	12,836	92,244	869	181

Year.	Pennsylvania, South Carolina, and South Dakota.	Tennessee.	Utah and Vermont.	Virginia.	West Virginia and other States.	Total.
1838–1879						410
1866–1879						19,950
1867–1879				18,000		23,500
1880				3,661	300	5,761
1881				3,295	300	4,895
1882				2,982	375	4,532
1883				5,355	[a] 400	6,155
1884				8,980	[a] 400	10,180
1885				18,745	50	23,258
1886		50		20,567		30,193
1887				19,835		34,524
1888	(Pa.) 22			17,646	[b] 50	29,198
1889	(S. C.) 124	30	(Vt.) 1,576	14,616		24,197
1890				12,699		[c] 19,287
1891	(S. Dak.) 19		(Vt.) 49	16,248		[c] 22,452
1892				6,079		13,613
1893		482		4,092		7,718
1894		922		1,797	(W. Va.) 100	6,308
1895	(Pa.) 460			1,715		9,547
1896	(Pa.) 265			2,018	(W. Va.) 13	10,088
1897	(Pa.) 354	11		3,650		11,108
1898		381		5,662		15,957
1899	(Pa.) 12	19		6,228	(W. Va.) 10	9,935
1900		30		7,881		11,771
1901		400	(Utah) 2,500	4,275		11,995
1902	(S. C.) 8			3,041		7,477
1903	(S. C.) 25		(Utah) 483	1,801		2,825
1904			(Utah) 32	3,054		3,146
1905		20		3,947		4,118
1906		30	(Utah) 800	6,028		6,921
1907	(S. C.) 800	100		4,604		5,604
Total	2,089	2,475	5,440	228,501	1,998	396,623

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[a] Georgia and North Carolina.

[b] Nevada, North Carolina, South Carolina, Tennessee, and Vermont.

[c] Colorado production of 1890 and 1891 published formerly as manganese is manganiferous ore and has been transferred to that table.

OCCURRENCE.

VERMONT.

Manganese ore occurs near the towns of South Wallingford and Brandon, in Otter Creek Valley, Vermont. In both localities the deposits are on the west slope of the Green Mountains at or near the contact of a "Lower Cambrian" quartzite, which forms ridges along the west slope, and an overlying limestone of approximately the same age, which underlies the valley to the west. The deposits are mainly brown hematite with subordinate manganese.

The South Wallingford deposit[a] consists of pockets of iron and manganese ores, occurring separately or mixed in all proportions. The manganese ore is massive black psilomelane with nests of crystalline pyrolusite. The ore occurs at intervals in a bed of yellow, red, and variegated clays at the contact of the quartzite and the limestone. This bed is almost vertical, dipping slightly to the west, and has a strike a little east of north. It has a probable average thickness of several hundred feet.

The Brandon deposit[b] is composed mainly of brown hematite and subordinately of manganese ore in brown and white surface clays adjacent to the limestone-quartzite contact. In similar clays in the same locality lignite and Tertiary fossils have been found; hence it seems possible that the ore-bearing clay is a surface deposit derived from an underlying clay bed equivalent to that found at South Wallingford. The manganese ore is mainly in the form of black amorphous psilomelane kidneys, sometimes containing nests of pyrolusite crystals. These kidneys are of various sizes and occur in pockets scattered through the clay, being often associated with iron ore masses.

VIRGINIA.

Manganese deposits occur in Virginia in the Piedmont region and in the Appalachian Valley.

The ore of the Piedmont region occurs in the James River Valley north and south of Lynchburg. There are a number of old mines in this district, but only one, that of the Piedmont Manganese Company, is at present producing. The deposits occur in residual clay and sand derived from ancient crystalline rocks. This material is still in place and often only partly decomposed, so that the texture and structure of the original rocks is clearly distinguishable. In general the ore occurs in nodular masses, ranging in weight up to 500 pounds and scattered through a yellowish-brown micaceous clay forming a nearly vertical layer between decomposed granite and quartzose mica schist residuum. The original nature of this ore-bearing layer is unknown.

The Piedmont Manganese Company's mine is situated on Beaver Creek, in Campbell County, about 7 miles southeast of Lynchburg. In the present workings the ore occurs in masses in a yellow and brown micaceous clay bed dipping steeply southeast and having a general northeast-southwest strike. This layer is between a decomposed granite on the hanging wall and a residual micaceous clay on the foot wall. The latter is very similar to the ore-bearing clay and grades into it, the ore increasing in quantity toward the granite contact. The hanging wall also grades into the ore deposit through a zone partially replaced by manganese oxide. The ore-bearing layer as exposed varies from 5 to 10 feet in thickness, but ore is said to occur at intervals for 50 feet from the hanging-wall granite. In places the ore masses are closely grouped, and the clay forms a very small part of the bed; while elsewhere the clay may make up over one-half of the layer. The length of the deposit is not known, but surface outcrops occur at intervals along the strike for a quarter of a mile northeast. The presence of ore-bearing layers parallel to the one now worked has been shown by surface pits.

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[a] Penrose, R. A. F., Manganese: Ann. Rept. Arkansas Geol. Survey, 1890, vol. 1, p. 392.

[b] Loc. cit., p. 395.

Apparently about the same conditions prevail in the old unworked mines of the district. In the Leets mine, about 1½ miles northeast of the preceding, ore occurs in a similar brownish-yellow micaceous clay between decomposed granite and schist and as a replacement of the adjacent part of the granite. Surface workings on the Saunders property, 1 mile east of Evington, show nodular ore in a yellow and red residual clay, having a decomposed mica schist as foot wall. In the Cabell and Piedmont mines, about 2 miles north of Warminster, granite and schist are again in evidence, but relations are somewhat obscured by the age of the workings.

A characteristic associate of many manganese deposits in the Piedmont region is a manganese-stained earth or clay known as "umber," which is a residuum of some formation as yet unknown. Crystalline limestone[a] has been found with it and may be a clue to its origin as well as to the origin of the deposits.

The Appalachian Valley deposits may be conveniently divided into two types, those of the Valley of Virginia and those of the New River region.

The chief deposits of the Valley of Virginia occur on the west slope of the Blue Ridge from Front Royal on the north to Roanoke on the south. Through this area manganese deposits are found at irregular intervals near the foot of the mountains. The same region includes the Blue Ridge iron-ore mines, most of which contain some manganese ore, frequently in such quantity as to form a manganiferous iron ore. Similarly, most of the manganese deposits contain some iron, especially near the surface.

The Blue Ridge occupies the contact between the ancient crystalline rocks of the Piedmont region and the Paleozoic sediments. The latter, although nearly vertical, have a general westward dip on the west slope of the mountains. The succession of formations from west to east is: Shenandoah limestone, Cambrian shale, and Cambrian quartzite. The Cambrian quartzite occupies the main west slope of the mountains; the shale, a gently sloping bench at the base; and the Shenandoah limestone, the valley to the west.

The manganese deposits occur in the shale area near the contact with the underlying quartzite. With a few exceptions they are pockets of local concentration occurring in residual clay. With regard to texture, the ore is of four varieties: (1) Kidneys of black psilomelane embedded at intervals in clay. (2) Irregular masses, often porous, of psilomelane with frequent layers or nests of crystalline pyrolusite, embedded in clay. This form is frequently assumed by local ore segregations in a manganiferous clay. (3) Breccia ore in large masses, with sandstone or chert fragments, and either psilomelane or pyrolusite as cementing material. (4) Replacement and cavity fillings in sandstone or sandy clay. This type is largely composed of crystalline and granular pyrolusite with associated psilomelane.

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[a] Watson, Thos. L., personal communication.

The manganese ores are widely distributed along the Blue Ridge ore belt, but it is only occasionally that they are sufficiently concentrated to form a workable deposit. In such deposits there are alternating layers, lenses, or irregular bodies of barren and ore-bearing clays. Frequently one body of clay will have a certain type of ore, while an adjacent mass will have another type. Of the numerous mines along this belt only the Crimora, the Lyndhurst, and the Vesuvius are at present in operation.

The Crimora mine is situated in Augusta County, about 2 miles east of Crimora station, on the Shenandoah Valley division of the Norfolk and Western Railroad. The ore deposit is located in an elliptical basin in a canoe-shaped syncline of the "Lower Cambrian" quartzite. The basin has a general north and south trend and is about a half a mile long, a quarter of a mile wide, and about 200 feet deep. It is filled with yellow, red, and variegated clays. The ore is hard and of three varieties: (1) Kidney ore of black psilomelane, (2) replacement and cavity fillings of psilomelane and pyrolusite in sandy clay, and (3) irregular pockets in manganiferous clays. The ore masses occur segregated in local layers, lenses, and irregular bodies of clay, separated by barren areas. Near the surface it is quite ferruginous. In the eighties and early nineties the Crimora mine consisted mainly of underground workings. About 1895 these were abandoned and operations begun for a system of hydraulic mining. A tunnel over a mile in length was cut westward from the lower part of the basin through the western rim, thus draining the entire basin above it. Water was brought to the mine by flues from several points in the surrounding mountains. This system, however, has never been put fully into operation. The Crimora mine consists of a large open pit near the center of which there is a shaft connection with the long drainage tunnel. At present operations are conducted on a very small scale, and consist in taking out the ore left between the old levels. There are still about 135 feet of workable ground left between the bottom of the pit and the level of the tunnel, and nearly half of this is untouched by former workings.

The Lyndhurst mine is located in Augusta County, about 2½ miles south of Lyndhurst, on the Shenandoah Valley division of the Norfolk and Western Railroad. This deposit consists of (1) scattered kidneys and (2) irregular masses in clay. The former occur in small, irregular nodules averaging an inch or two in diameter, but occasionally reaching 5 or 6 inches. These are scattered through horizontal layers or lenses of red, brown, and variegated clays at intervals of a few inches to a foot or more. Mingled with the light-colored clays are layers and lenses of dark manganiferous clays which contain the second type of ore. The ore varies from seams to irregular masses of various sizes, both hard and soft. The ore occurs scattered at irregular intervals in a pocket which has been tested to a depth of 60 feet and a horizontal extent of 300 yards. On account of the scattered nature of the ore, much dirt has to be washed to get a small quantity of ore. The extent of the deposit, however, seems to be such as to warrant this expense. The mine consists of several shafts, with drifts at five levels.

The Vesuvius mine also is located in Augusta County, about 1½ miles northeast of Vesuvius. The deposit is in a pocket, whose extent has not yet been determined, at the foot of the Blue Ridge. The workings consist of some old open pits, a shaft with underground workings recently abandoned, and a new shaft started west of the old workings. The ore is of two varieties: (1) Breccia, occurring in large masses, with chert or sandstone fragments and either psilomelane or pyrolusite as cement, and (2) kidneys of ore from 3 to 6 inches in diameter, embedded in clay. The breccia ore masses frequently have a thick coating of botryoidal psilomelane.

Besides those mentioned, there are many unworked mines in this belt. Among them are the Old Dominion, which occupies the southern part of the Crimora basin, Augusta County; the Watt property, east of Dooms Crossing, Augusta County; the Kennedy and Mount Torry tracts, east of Stuarts Draft, Augusta County; the Midvale mine, east of Midvale, Rockbridge County; Gowen's bank, east of Lithia, Botetourt County; and the Houston banks, northeast of Troutville, Botetourt County. The ore mined on the Old Dominion property has been mainly ferruginous surface ore. With depth they will probably strike the same ore as that found in the Crimora mine. The Watt property ore consists of masses of mixed psilomelane and pyrolusite with sandy clay fragments. On the Mount Torry and Kennedy properties the surface ore consists of ferruginous botryoidal and porous masses. The Kennedy open pit contains psilomelane kidneys near the bottom. Gowen's bank contains soft, blue ore; and the manganese ore shown in the Houston banks is mainly blue granular pyrolusite occurring as seams and replacements in sandstone horses. Some irregular masses of psilomelane and pyrolusite occur in the clays together with brown hematite ore. Other deposits in the Blue Ridge belt occur east of Stanleyton in Page County; and of Elkton and Grottoes in Rockingham County; and both manganese and manganiferous iron occur in most of the iron-ore mines. Some of the latter, like Mine Bank, 6 miles northeast of Vesuvius, consist almost entirely of manganiferous iron ores.

The manganese deposits of the New River region occur in several belts south of Pulaski, Wytheville, and Marion. The ores occur here associated with the lower part of the Shenandoah limestone,[a] and almost invariably iron ores are associated with them. In the deposits visited the ores do not seem to occur as kidney masses so prevalent elsewhere in Virginia, but rather in large, porous masses, containing varying quantities of brown hematite ore and much included clay and sand. Very little ore has been produced in this district, most of it coming from the Umbarger and the Currin Valley mines, southeast of Marion.

The Umbarger mine is situated about 1½ miles east of Sugar Grove, Smyth County. The main ore deposit consists of large masses of mixed porous psilomelane, brown hematite, and sandy clay. These masses range in size up to 6 or 8 feet in extent, are of irregular shape, and occur in yellow or red clays. Ore has been taken out from a few cuts near the surface. Besides this, ore occurs scattered through a considerable area as small, irregular nodular masses, mainly psilomelane with some included pyrolusite, in yellow and red clay.

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[a] Holden, R. J., personal communication.

The Currin Valley mine is located about 1½ miles south of Attoway, Smyth County. The workings consist of a large open pit from which considerable brown hematite has been taken. The ore occurs in large masses and is a mixture of manganese ore, brown hematite, and sand or clay, occurring locally in variegated clay. Manganese ore also occurs at the Atkins mine, southeast of Attoway; on the Walker and Tate properties north of Sugar Grove; at the Eagle Cliff mine near Ivanhoe, Wythe County; at Allisonia, Pulaski County; and at several localities south of Wytheville.

Manganese ore is found at several localities in Virginia outside of the three districts mentioned, among which are those occurring in the Oriskany iron-ore area in Shenandoah and Frederick counties near Seven Fountains and Cedar Creek. Small deposits occur near Dagger Springs, Botetourt County, and at other localities to the southwest.

TENNESSEE.

The manganese ores of Tennessee are the southward continuation of the Appalachian Valley deposits of Virginia. As in Virginia, they occur near the eastern border of the valley. The best known of the Tennessee deposits occur in the vicinity of Newport and Del Rio, Cocke County, and in Shady Valley, Johnson County.

The Yellow Springs mine, on English Mountain, 5 miles southwest of Newport, consists of an open pit in brown and red clays and sand, residual from Cambrian quartzite. The ore is both soft and hard, the former generally occurring in irregular pockets and seams associated with manganiferous clays, and the latter in small kidneys and irregular masses scattered through the clay and the soft ore pockets. There are numerous surface indications of manganese for several miles east of this mine, but little or no development work has been done.

The ore deposits at Del Rio were not visited, but are reported to have similar associations.

In Shady Valley[a] manganese deposits occur associated with brown hematite in residual clays probably derived from the Shady limestone. They are situated in the northern part of the valley, north of Cross Mountain.

Irregular masses of amorphous blue psilomelane occur with iron ores in residual red clays of the Knox dolomite about 1½ miles northeast of Sweetwater, Monroe County.[b]

NORTH CAROLINA AND SOUTH CAROLINA.

Manganese deposits are known in the crystalline rocks between Kings Mountain, N. C., and Blacksburg, S. C., and with similar associations near McCormick, Abbeville County, S. C.

GEORGIA.

Manganese ores occur in Georiga in three horizons: (1) The ancient crystalline rocks, (2) Weisner (Cambrian) quartzite, and (3) Knox (Cambro-Silurian) dolomite. The following is a general succession of rocks for northwestern Georgia from top to bottom: Knox dolomite;

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[a] Penrose, R. A. F., jr., loc. cit., p. 414.

[b] Burchard, E. F., personal communication.

Conasauga shale; Beaver limestone; Weisner quartzite; Crystalline rocks.

In the crystalline area[a] ores occur at Mount Airy, Habersham County; Bowersville, Hart County; Blue Ridge, Fannin County; and Draketown, Haralson and Paulding counties. All of these deposits are small, and none of them have been worked to any extent.

Northeast, east, and southeast of Cartersville, Bartow County, in the area underlain by Weisner quartzite and Beaver limestone, there are extensive deposits of manganese in residual clays. In late years none of the mines have been operating, and no ore is being produced at present. The larger deposits of the district are the Chumbley Hill and Moccasin mines, east of White's; the Dobbins mine, the Milner-Harris mine, Lot 274, the Mayburn mine (Lot 303), and Lots 305 and 306, northeast of Cartersville; Lot 460, east of Cartersville; Lot 465, southeast of Cartersville; and the Stegall property, northeast of Emerson.

The ore is of four varieties: (1) Kidney ore, either amorphous, blue psilomelane, or a succession of concentric layers of psilomelane and crystalline and granular pyrolusite; (2) irregular masses, either psilomelane or a mixture of psilomelane and pyrolusite; (3) breccia and replacement ore with chert or sandstone fragments, and (4) seams and irregular pockets of soft ore with local hard masses, a large portion of which must necessarily be lost during washing. The clays of the district are yellowish brown or red, according as they are derived from the Weisner quartzite or the Beaver limestone.[b] The ores are generally associated with the former, and signs of manganese are present throughout the area covered by them, although only locally are there deposits rich enough to work. The breccia ores occur in residual sandstone or chert masses in the clays.

The Chumbley Hill mine is a large, circular, open pit in yellow, brown, and variegated clays containing local concentrations of kidney ore. The fragments range in size from a few inches to a foot, but as a rule are 3 or 4 inches in diameter. They are embedded in yellow and brown sandy clay and are composed of concentric layers of psilomelane and crystalline pyrolusite. The Moccasin mine, a quarter of a mile to the east, contains the same type of ore.

The Dobbins mine consists of a shaft and several open pits in yellow and brown clay, with local masses of darkly stained manganiferous clay. The main pit contains a large mass of breccia ore, but the principal deposits are seams and pockets of soft blue crystalline ore with local hard masses. These deposits are distributed through sandy clay, and range in size from mere seams to masses several feet in extent. The latter generally contain small pockets of sandy clay.

The Milner-Harris mine consists of abandoned shafts and underground workings. The ore on the dumps appeared to be of the same type as the Dobbins ore.

Lot 274 and the Mayburn mine are northeast of the Milner-Harris and Dobbins mines. The workings consist mainly of old open pits. The ore occurs in kidneys or in irregular masses, composed either of psilomelane, pyrolusite, or a mixture of both. The former are embedded in yellow or brown clay; the latter frequently in dark manganiferous clay. Kidneys of beautiful needle ore (pyrolusite) are abundant in the Mayburn mine. Lot 274 contains considerable manganiferous iron ore near the surface.

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[a] Watson, Thos. L., Preliminary report on the manganese deposits of Georgia: Geol. Survey Georgia, Bull. 19, 1908, p. 158.
[b] Watson, Thos. L., loc. cit.

Lot 460 is about 1 mile east of Cartersville. The ore occurs in porous, irregular, ferruginous masses distributed along bands through reddish-brown clay.

Lot 465 is about 1½ miles south of Lot 460. The ore here also is ferruginous and very much like that on Lot 460. This lot also contains some deposits of breccia ore and kidneys of amorphous blue psilomelane.

These are the best known deposits, but others of smaller extent occur in surrounding and intervening areas and have ores similar in form and manner of occurrence to those described.

The areas where manganese ores occur in residual clays of the Knox dolomite are those around Cave Spring, Floyd County, and at Tunnel Hill, Whitfield County. These clays are generally dark red in color where derived from the Knox dolomite and of lighter variegated color where residual from the associated shale. In the former clays the ore occurs as (1) cement in residual masses of chert breccia; (2) in porous irregular masses ranging in size up to a foot in diameter, and (3) as pellet ore derived from disintegration of the last named. In the lighter-colored clays the ore occurs as (1) cement in sandstone breccia or (2) as blue psilomelane kidney ore. The main mines of the Cave Spring district are Reynolds Mountain, the Lowe mine, the Scarborough tract, and the Sanders property.

The Reynolds Mountain deposit is located about 6 miles north of Cedartown. The workings consist of several pits, most of which have caved in. The ore is dark blue, partly crystalline, and occurs as cement in large masses of brecciated chert and as irregular porous fragments in the surrounding red clay.

The Lowe mine, about 3 miles southeast of Cave Spring, consists of a large open pit in dark-red clay. The ore occurs mainly in the form of small pellets, ranging up to one-third of an inch in diameter, with local larger masses of porous ore. Below the red clay is a variegated clay which contains ore associated with large areas of manganiferous clay.

On the Scarborough tract, about 4½ miles southwest of Cave Spring, there are several pits in light-colored variegated clays in which the ore occurs in breccia masses and kidneys of blue psilomelane. In the breccia the fragments form but a subordinate part, the main mass being a mixture of psilomelane and pyrolusite.

The Sanders property is located about 2½ miles south of Cave Spring. The workings consist of several pits in variegated clays, in which the ore occurs as (1) soft-ore pockets and (2) small kidneys. Both forms commonly occur in manganiferous clay, the former frequently containing hard, irregular, partly crystalline masses. The kidneys are commonly only an inch or two in diameter and are composed of psilomelane.

At Tunnel Hill[a] the ore occurs in kidneys, separately and in nests, in dark-red clay. The ore is both massive and crystalline. Irregular masses of manganiferous iron ore are abundant.

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[a] Watson, Thos. L., loc. cit.

ARKANSAS.

Manganese ores of commercial importance have long been known in the Batesville district, in northern Arkansas. Smaller deposits occur in the southwestern part of the State, but these have not produced up to the present.

The Batesville district is located north of Batesville and east of Cushman, in Independence County. The country rock ranges from Cambrian to Carboniferous in age, and is in horizontal beds. The following is the general succession of rocks for the district:[a]

General section in Batesville region of northern Arkansas.

Boone chert,
St. Joe marble, (Carboniferous).
Chattanooga shale and Sylamore sandstone (Devonian).
St. Clair limestone (Silurian).
Cason shale,
Polk Bayou limestone,
Izard limestone,
Key sandstone,[b] (Ordovician).

Manganese ores occur in three different associations in the Batesville district, but all of them at very nearly the same geological horizon, namely, between the Boone chert and the Polk Bayou limestone, or locally the Izard limestone, where the Polk Bayou is absent. (1) The Cason shale locally becomes red and sandy and contains an abundance of small lenticular manganiferous iron nodules constituting a low-grade manganiferous iron ore deposit. This bed where exposed is 10 feet or more in thickness. (2) In most of the mines of the district the horizon normally occupied by the formations given above, between the Boone chert and the Polk Bayou limestone, is occupied by a manganese-bearing bed of varying nature, which appears to be partly residual from the erosion of other rocks formerly occupying this horizon and partly deposition of new material. This bed is also called the Cason shale, and although occupying a wider horizon is presumably equivalent to (1). It varies in thickness from a few inches to many feet because of the irregular surface of the underlying Polk Bayou limestone. The formation consists sometimes of clay with manganese ore fragments, sometimes of a solid bed of sandy, low-grade ore with associated sediments, and at other times of partial replacement of sediments. (3) The remaining forms of manganese deposits are associated with residual clays on the slopes of hills below the main manganese horizon above mentioned. These deposits consist of masses of psilomelane, pyrolusite, and braunite, and are reconcentrations from the manganese bed above. Only one mine in the district, the Cason, was a producer in 1907, but several deposits have been worked recently, among them the Reeves, Bales, Roach, and Meeker mines. The principal old mines are the Southern, Polk-Southerd, Turner, Adler, Trent, Baxter, and Montgomery mines.

The Cason, located about 3½ miles north of Batesville, is the only mine in the district which has worked the nodular manganiferous phases of the Cason shale. This is really a manganiferous iron ore and not manganese ore, but it is given here on account of its associations. The ore is quarried rather than mined from two large cuts, the bed worked being about 10 feet thick and lying horizontal. It consists largely of red sandy shale with lenticular manganiferous iron nodules lying in the plane of stratification and averaging between a half inch and 2 inches in larger diameter and from one-fourth to one-third of an inch in thickness. They are very closely spaced, making up more than half of the formation.

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[a] Purdue, A. H., Developed phosphate deposits of northern Arkansas: Bull. U. S. Geol. Survey No. 315, 1907, p. 463.

[b] Inserted by the writer. See Adams, G. I., and others, Zinc and Lead deposits of northern Arkansas: Prof. Paper U. S. Geol. Survey No. 24, 1904.

The Reeves mine is situated on Cave Creek, about 6 miles northeast of Batesville. The ore occurs in large and small masses scattered through horizontally bedded manganiferous earth. The ore masses are compact or spongy, the former being largely braunite and the latter psilomelane or pyrolusite.

The Bales mine is on Cave Creek, about 2 miles east of the Reeves mine. The ore occurs in manganiferous earth in irregularities on the surface of the Polk Bayou limestone on the upper slopes of ridges capped by Boone chert. The ore is mainly of the spongy blue variety. Considerable replacement of the underlying limestone by manganese has taken place.

The Meeker mine is on the horizon between the Boone chert and the Polk Bayou limestone, a half mile west of Cushman. The bed here consists of a few feet of sandstone and shale underlain by a ferruginous manganese formation varying in thickness from a few inches to 6 or 8 feet, the irregularity being due to the undulating surface of the underlying limestone. The material is fairly hard and consists of interlaminated manganese and iron oxides with sandy and shaly material, the whole forming a low-grade ore bed. Here and there are pockets of richer ore.

At the Roach mine, about 9 miles north of Batesville, the deposit occurs on a hill which lies in a basin of the Key sandstone. The deposit consists of a mixture of breccia ore, kidney ore, and manganiferous earth replacing clay. The deposit occurs in dark-brown and chocolate clays. The breccia ore forms large masses often 5 or 6 feet in extent, composed of chert fragments cemented with manganese oxide. The kidney-ore masses average about 3 or 4 inches in diameter and are embedded in chocolate clays. They frequently contain chert fragments, while, on the other hand, the breccia masses often have pure nodular psilomelane on the surface. The manganiferous earth occurs in large quantities with the other forms.

The Baxter and Montgomery mines are about half a mile east of the Roach mine. The ore at these mines occurs in red and brown clays on the surface of the Polk Bayou limestone, but the Boone chert is not in evidence. Dark-red masses, which appear to be decomposed shale and limestone, are seen in the clays. The ore is of two kinds—(1) a thin layer of porous blue ore apparently sedimentary or replacements of sedimentary material interbedded with red shale containing (2) small lenticular ore nodules similar to those of the Cason mine.

The Adler mine is about three-quarters of a mile northeast of the Reeves mine. Some of the pits are at the main manganese layer between the Polk Bayou limestone and the Boone chert, while others are on the slopes below. The workings are old, and no ore could be seen in them at the time of the writer's visit.

The Trent mine is about 1 mile west of the Reeves mine. The ore is in dark clay on the Polk Bayou limestone, horses of which extend up into the clay. The ore consists of irregular masses of gray crystalline or amorphous braunite and psilomelane.

The Turner mine is about 2½ miles northeast of Cushman. The ore is spongy blue psilomelane and gray crystalline braunite in irregular masses scattered through reddish-brown clays on the surface of the Izard limestone. The Polk Bayou limestone appears to be absent, but the Boone chert is present locally above the clay.

The Polk-Southerd mine is about a half-mile southwest of the Turner, but the pits are old and nothing could be seen except that the Boone chert formed the upper part of the walls.

The Southern mine is about 1 mile northeast of Cushman. It consists of a number of old open pits and shafts. The latter go through the Boone chert into the underlying manganese-bearing layer. The rock underlying this layer is the Polk Bayou limestone, as shown in the Grubb cut, a little to the northeast. In the pits ocherous and manganiferous clay is exposed under the Boone chert. This clay contains manganese ore masses here and there.

UTAH.

Several deposits of manganese are known in Utah, and others are being discovered. The best known deposits are located in Grand County, about 10 miles south of Little Grande, a station on the Rio Grande Western Railroad. The ore here occurs as a replacement of calcareous layers along a certain horizon in the Triassic sandstone series. Above this horizon are beds of white and gray quartzite; below it are red thin-bedded calcareous sandstones grading downward into the massive red Vermilion Cliff sandstone. The ore, consisting of blue granular and crystalline pyrolusite, is found abundantly as float and replacement of layers and pockets in the bed rock near the surface, where the overlying rocks have been eroded.

Two deposits have recently been discovered in western Utah, one in Iron County near Modena and one near Joy in Juab County. The former is associated with iron ore in decomposed limestone on the foot wall of an igneous dike. The limestone is decomposed for a number of feet on either side of the dike due to its intrusion. The manganese ore is principally wad. Near Joy the ore is said to occur as a deposit at the contact of granite and limestone, the former being on the foot wall. No ore has been taken from this area because of lack of railroad facilities.

NEVADA.

A small deposit of manganese occurs 2 miles east of Golconda, Nev. It is bedded and varies in thickness from a few inches to 3 feet, and is interstratified with calcareous and siliceous tufa. There is good evidence that this is a hot-springs deposit in a small basin in the tufa, as supposed vents of the spring are seen on the slopes of the hills above it. The ore is mainly wad in black powder, or small fragments, slightly consolidated.

CALIFORNIA.

Manganese ore occurs in California in two different associations: (1) Near Meadow Valley in Plumas County pyrolusite and psilomelane occur in veins in the Calaveras clay slate formation; (2) near the coast, north and south of San Francisco, ore occurs as local small, thin lenses interbedded with cherts of the Franciscan or Golden Gate series. The most important deposits of this nature found up to the present are those located southeast of Livermore in Alameda and Santa Clara counties. Among these deposits are the old Ladd, the Fable, and the Isler Mountain mines, and the Overacker property. The ore is supposed to be largely in the form of manganite[a] and an impure oxide.

In the Ladd mine the ore occurs in what appears to be a fault fissure having a general direction of N. 60° W., and dipping very steeply to the south. The fissure averages about 4 or 5 feet in width with a hanging wall of massive pink chert and a foot wall of thin, bedded gray chert and clay. It has been mined to considerable depth in open cuts along the strike. The ore occurs as cavity fillings, as infiltration and replacement in red and yellow clays in the fissure, and as veins and breccia cement in the massive south wall. It is black in color and hard or soft according as it is associated with clays or with the jasper wall.

Along the strike of this fissure about half a mile to the west is a more recent opening consisting of an incline and stopes. The associations here are the same.

The other deposits of the Livermore district are of a different nature. They consist of small lenses ranging up to 100 or more feet in extent, and from a few inches to 5 feet or more in thickness. These lenses appear to be interbedded with the chert layers and consist of black porous ore with seams of quartz. Along the edges there is frequently considerable replacement of chert by manganese oxide.

Manganese indications are found throughout the Franciscan chert area of west-central California, and small deposits occur locally. Among them are those of Red Rock Island and Sausalito, near San Francisco, those of the Russian River Valley, and a few east of Tres Pinos. So far, however, these have not been found to be of commercial importance.

IMPORTS.

During 1907 there were 209,032 long tons of manganese ore, valued at $1,793,143, imported for consumption into the United States. The importation in 1906 amounted to 221,260 tons, valued at $1,696,043. The imports of 1907 show a decrease in tonnage compared with those of 1906, but an increase in value, indicating that the price of foreign manganese ores has risen. On account of the small domestic production of manganese ores and the small portion of even this product used in making spiegeleisen and ferromanganese, the importation of foreign manganese ore is a matter of considerable and increasing importance as the iron and steel industry in this country develops.

By far the largest quantity of manganese ore imported was obtained from India, where large deposits have been developed in the last few years, in which considerable American capital is already invested.

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[a] Penrose, R. A. F., loc. cit., p. 481.

Cuba and Brazil furnished considerable ore, and small quantities were imported from Germany, Great Britain, and other countries.

The following table shows the total quantity of manganese ore imported into the United States as far as has been recorded. The figures from 1868 to 1888 represent imports from Canada only, those from 1889 to the present time represent total imports.

Imports of manganese ore into the United States, 1868–1907, in long tons.

Year ending—	Quantity.	Year ending—	Quantity.
June 30—		December 31—Continued.	
1868	1,017	1888	1,182
1869	488	1889 [a]	4,286
1870	1,402	1890	34,154
1871	1,056	1891	28,825
1872	1,206	1892	58,572
1873	838	1893	68,113
December 31—		1894	44,655
1873	1,031	1895	86,111
1874	782	1896	31,489
1875	203	1897	119,961
1876	412	1898	114,885
1877	891	1899	188,349
1878	626	1900	256,252
1879	1,886	1901	165,722
1880	2,179	1902	235,576
1881	1,704	1903	146,056
1882	894	1904	108,519
1883	1,326	1905	257,033
1884	603	1906	221,260
1885	1,684	1907	209,032
1886	1,818		
1887	1,630	Total	[b]2,403,708

[a] Figures prior to 1889 represent imports from Canada only, total importations from other countries for these years not being obtainable.

[b] This total duplicates the importation from January 1 to June 30, 1873.

The following tables, compiled from statistics furnished by the Bureau of Statistics, Department of Commerce and Labor, show the imports of manganese ore into the United States from different countries and by ports of entry, for 1905, 1906, and 1907:

Imports of manganese ores into the United States, 1905–1907, by countries, in long tons.

Country.	1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Brazil	114,670	$1,058,478	30,260	$300,466	52,922	$522,510
Russia	24,650	202,774	13,805	109,814	1,000	19,570
British India	101,030	501,423	154,180	939,984	95,300	552,228
Cuba	6,489	35,049	11,701	117,050	30,006	262,847
East Indies					12,552	82,832
France					1,588	31,536
Netherlands					1,795	35,473
Japan	1,329	13,950	2,000	21,664	1,787	15,020
Germany	2,336	54,150	4,386	112,511	6,713	150,388
United Kingdom	1,298	30,555	1,330	37,711	3,999	96,833
Canada	7	575	112	1,125	16	500
Spain	50	708				
Belgium	80	1,762	1,710	30,377	1,354	23,406
All other countries	5,094	52,983	1,776	25,341		
Total	257,033	1,952,407	221,260	1,696,043	209,032	1,793,143

Manganese ores imported into the United States, 1905–1907, by customs districts, in long tons.

Customs districts.	1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Philadelphia, Pa	117,591	$822,525	93,590	$682,485	106,494	$888,239
Baltimore, Md	126,018	993,163	120,051	860,112	92,331	694,732
New York, N. Y	5,954	90,942	6,802	136,037	7,869	177,323
Chicago, Ill	20	496	239	10,096	276	11,839
Boston, Mass	4	127	5	209		
New Orleans, La	199	1,822	411	3,675	1,946	16,539
Pensacola, Fla	650	4,284				
Mobile, Ala	6,489	35,049				
All others	108	3,999	162	3,429	116	4,471
Total	257,033	1,952,407	221,260	1,696,043	209,032	1,793,143

WORLD'S PRODUCTION.

The following table gives the latest available statistics with regard to the world's production of manganese ore. The unit is either the long or the metric ton, except for Canada, where the short ton is used.

World's production of manganese ores.

Country.	Year.	Quantity.	Country.	Year.	Quantity.
North America:		*Tons.*	Europe—Continued.		*Tons.*
United States	1907	6,404	United Kingdom	1906	22,762
Canada[a]	1906	93	Portugal	1903	30
Cuba	1907	34,171	Russia	1905	426,813
South America:			Spain	1905	26,020
Brazil[a]	1905	233,950	Sweden	1906	2,700
Chile	1905	1,324	Turkey[a]	1905	28,600
Europe:			Norway	1904	22
Austria	1906	13,400	Asia:		
Bosnia and Herzegovina	1905	4,129	India	1905	253,896
Hungary	1905	9,943	Japan	1905	11,162
France	1906	11,200	Java	1905	1,600
Germany	1906	52,500	Oceania:		
Greece	1905	8,171	Queensland	1905	1,517
Italy	1906	3,000	New Zealand	1905	55

[a] Exports.

MANGANIFEROUS ORES.

INTRODUCTION.

Manganiferous ores as here given include those ores which besides an appreciable quantity of manganese contain other metals, as iron, silver, gold, and lead. The principal types of manganiferous ores are: (1) Manganiferous iron ores and (2) manganiferous silver ores. The latter generally, though not always, contain a large percentage of iron. The first of these classes includes the manganiferous iron ores of the Appalachian region, the Lake Superior region, and the Mississippi Valley; the second includes the low-grade gangue of many metalliferous veins in the West, especially the oxidized portions of such veins.

High-grade manganiferous iron ores are used in the manufacture of spiegeleisen and ferromanganese. Deposits of such ores occur in the Appalachian region, but there has been no production in recent years.

In most of the low-grade manganiferous iron ores the manganese is not utilized and generally is considered an undesirable constituent. This is true of the Lake Superior ores and of numerous deposits in the Appalachian region. The low-grade manganiferous iron ores are included under iron ores.

Manganiferous silver ores may be divided into four classes according to their uses: (*a*) The greater portion of the manganiferous silver ores are used for their silver and lead content, and are included under precious metal production. The manganese and iron content often insures these ores a higher price because of their fluxing value. (*b*) The second class of manganiferous silver ore is too low in silver and lead to be used as sources for these metals, but sufficiently high in manganese and iron to be used for the manufacture of ferromanganese and spiegeleisen, as is the case with the high grade manganiferous iron ores mentioned above. The Leadville district is the only one from which this class of ore has been recorded. Prior to 1906 the output was included under iron ores and noted under manganiferous iron ores, while, in 1906, it was included under manganiferous iron ores only. In the present report, and henceforth, it will be considered as a manganiferous silver ore, and will be included under the general head of manganiferous ores, but separated as to its use. (*c*) In some localities, as at Silver City, N. Mex., this class of ore is too low in manganese to be used for the manufacture of spiegeleisen and ferromanganese, and is used simply as an iron ore. (*d*) There is a fourth class of manganiferous silver ore too low in silver and lead to be used primarily for these metals and too low in iron and manganese to be used for the manufacture of spiegeleisen and ferromanganese. This ore is sold to the smelters as flux, the iron and manganese becoming a waste product. The silver and lead content is recovered during the smelting, and is included in the production tables of these metals. Prior to 1906 this fourth class of ore was included under iron ores and noted under manganiferous silver ores, or manganiferous argentiferous iron ores, but in 1906 it was not recorded. In the present report it is given as a manganiferous silver ore included under the general head of manganiferous ores, but separated as to its use.

Flux ore is mined in many lead and silver districts of the West, but, up to the present, has been recorded mainly from Leadville, Colo., with a small quantity from Neihart and other places in Montana.

MANGANIFEROUS IRON ORES.

Appalachian Valley.—The manganiferous iron ores of the Appalachian Valley include deposits or parts of deposits of brown hematite rich in manganese, and manganese deposits rich in iron, in the States of Vermont, Pennsylvania, Virginia, Tennessee, North Carolina, and Georgia. The most important ones are those in Vermont, Virginia, and Tennessee, and have been mentioned in the descriptions of manganese deposits. These ores vary from a coarse mixture of manganese and iron oxides easily separated to a mixture indistinguishable to the eye.

Arkansas.—The manganiferous iron ores of Arkansas occur in or very near the manganese horizon and are described with the manganese deposits of that State.

Lake Superior district.—Much of the ore of the Lake Superior district contains between 1 and 10 per cent metallic manganese. It occurs in the form of oxide, probably pyrolusite, intimately mixed with red hematite. This ore is not used for the manufacture of ferromanganese or spiegeleisen, the manganese contained being rather an obstacle than a benefit. For this reason the production is listed under iron ores and simply repeated here for the sake of completeness.

Most of the manganiferous iron ores of the district have come from the Gogebic, Menominee, Mesabi, and Marquette ranges. At present, however, numerous deposits of manganiferous iron ore are being discovered on the Cuyuna Range of central Minnesota, where it occurs as local bodies in iron ore deposits.

Colorado.—Manganiferous iron ores are found in the Cebolla district in Gunnison County, Colo. Manganese oxide is here associated with limonite in clay, a surface alteration of an iron carbonate in localities adjacent to a trachyte capping.[a]

MANGANIFEROUS SILVER ORES.

Colorado.—Manganiferous silver ores occur at Leadville, Colo., in large deposits at or near the contact of porphyry and blue limestone, replacing the latter. These deposits consist of a black mixture of manganese and iron oxides with lead carbonate and silver. The manganese content varies from 10 to 40 per cent, and according as the manganese is high the iron is low and conversely. Manganese and iron oxides are associated only with the oxidized portions of the Leadville deposits. In the lower unoxidized portions the minerals are mainly pyrite, marcasite, sphalerite, and galena. Manganese minerals are conspicuously absent and it is believed that the large quantity of manganese oxide in the oxidized ore is due to infiltration from the porphyry.[b]

Montana.—Manganiferous silver ores occur in veins in the Butte granite at Butte, Mont. These veins traverse the area north, west, and south of Butte, nearly surrounding the copper area. In the latter little or no silver ore occurs. The outcrops and upper portions of the silver veins are black, and consist of a mixture of quartz and manganese oxides, mainly wad carrying silver. At depth the veins are white and pink, and consist of silver and lead sulphides, with some pyrite, chalcopyrite, and locally sphalerite, in a gangue of quartz, rhodonite, and some rhodochrosite. In the Black Rock mine, where the veins are typically developed, the change takes place at a depth of between 150 and 300 feet. The veins vary in width up to 100 feet or more, a large part of them generally being made up of included lenses of granite. The veins are branching and anastomosing, but all have a general east and west direction ranging between northeast-southwest and southeast-northwest.

The manganese ores of Butte have been of little value commercially. In a few places the oxidized ore has been mined, in former years, mainly for its manganese content for use as flux in smelting; but as a rule the ore is mined for its silver.

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[a] Leith, C. K., Iron ores of the West: Bull. U. S. Geol. Survey No. 285, 1906, p. 17.

[b] Emmons, S. F., and Irving, J. D., Downtown district of Leadville, Colo.: Bull. U. S. Geol. Survey No. 320, 1907, p. 34.

Other States.—Manganiferous silver ores occur at Silver City, N. Mex., Tombstone, Ariz.; Tintic and Frisco, Utah; and Pioche and Eureka, Nev. The ores of Silver City, N. Mex., have an average manganese content of about 5 per cent and an iron content of about 45 per cent, and are used mainly for their iron, as is the case with the Lake Superior ores.

PRODUCTION OF MANGANIFEROUS ORES.

The total production of manganiferous ores in the United States in 1907 amounted to 103,844 long tons, valued at $259,473. The only portion of this product used in the production of ferromanganese and spiegeleisen was 67,514 tons, valued at $153,328, of the Leadville manganiferous silver ore.

The following table gives the quantity, value, average price per ton, and manganese content of the manganiferous silver ores of Colorado used in the manufacture of spiegeleisen and ferromanganese during the years 1905, 1906, and 1907:

Production of Colorado manganiferous silver ores used in the manufacture of ferromanganese and spiegeleisen, 1905–1907, in long tons.

Year.	Percentage of manganese.	Quantity.	Value.	Average price per ton.
1905	14–41	45,837	$110,497	$2.41
1906	26–36	32,400	97,600	3.01
1907	10–25	67,514	153,328	2.27
Total	10–41	145,751	361,425	2.48

Considerable Leadville flux ore was sold to the smelters in 1907 to be used in the reduction of silver and copper. The same is probably true of other silver districts in the West which have been overlooked with regard to this class of ore. The use made of the Arkansas product is not definitely known, although it was not used in the manufacture of ferromanganese and spiegeleisen.

The following table gives the quantity, value, average price per ton, and manganese content of the Colorado flux ore and of the Arkansas product for 1905, 1906, and 1907, the only States from which returns have been received:

Production of manganiferous ores used for fluxing or other purposes in Colorado and Arkansas, 1905–1907, in long tons.

Year.	State.	Percentage of manganese.	Quantity.	Value.	Average price per ton.
1905	Arkansas	28	3,321	$6,642	$2.00
	Colorado		81,738	270,299	3.31
1906	Arkansas	20–25	8,900	24,800	2.79
1907	Arkansas	14	4,133	8,266	2.00
	Colorado	8–26	32,197	[a]97,879	3.04
Total		8–28	130,289	407,886	3.13

[a] Partly estimated.

The manganese content of the Lake Superior and New Mexico manganiferous ores was not directly utilized.

The following table shows the total production of manganiferous ores in the United States, as far as known. The product of Colorado and Montana is manganiferous silver ore; that of the other States manganiferous iron ore. The manganiferous silver ores used in the manufacture of ferromanganese and spiegeleisen are separated from those used as flux.

Production of manganiferous ores in the United States, 1885–1907, in long tons.

Year.	Arkansas.	Colorado.[a]	Colorado.[b]	Lake Superior region.	Virginia.	Other States.	Total.
1885						(Mont.) [b] 4,263	4,263
1886			[c] 60,000	257,000			317,000
1887			[c] 60,000	210,000	1,025	[d] 726	271,751
1888			[c] 60,000	201,036		[e] 1,096	262,132
1889			64,987	81,359			146,346
1890		[f] 6,397	51,840	61,863			120,100
1891		[f] 964	79,511	132,511			212,986
1892		2,942	62,309	147,431	3,000		215,682
1893	160	5,766	55,962	110,648	1,188	(N. C.) 20	173,744
1894		7,022	31,687	198,466			237,175
1895		13,464	54,163	112,265			179,892
1896		9,072	138,079	329,640			476,791
1897		16,519	149,502	184,585		(Vt.) 1,200	351,806
1898		18,848	99,651	268,862		(Pa.) 100	387,461
1899		29,355	79,855	732,490			841,700
1900		43,303	188,509	334,274			566,086
1901		62,385	228,187	512,084		(N. C.) 20	802,676
1902		13,275	194,132	884,939	3,000		1,095,346
1903		14,856	179,205	566,835	2,802		763,698
1904	600	17,074	105,278	365,572			488,524
1905	3,321	45,837	81,738	720,098			850,994
1906	8,900	32,400	([g])	[h] 1,000,000			[h] 1,041,300
1907	4,133	67,514	32,197	314,316		(N. Mex.) 7,000	425,160
Total	17,114	406,993	2,056,792	7,726,274	11,015	14,425	10,232,613

[a] Manganiferous silver ore used in the manufacture of spiegeleisen and ferromanganese.

[b] Manganiferous silver ore used for flux; mainly from Colorado, but in a few cases probably including other Western States.

[c] Contains some Montana ore.

[d] Georgia 195 tons, Maine 50 tons, and Vermont 481 tons.

[e] North Carolina, South Carolina, and Tennessee 96 tons, and Vermont 1,000 tons.

[f] Published as manganese ore in previous volumes of Mineral Resources.

[g] Not recorded.

[h] Estimated.

MANGANIFEROUS RESIDUUM FROM ZINC ROASTING.

The material classed under this head is a residual product from certain zinc oxide works using New Jersey zinc ores. The crude ore consists of a mixture of franklinite and willemite, the former being predominant. During the roasting the bulk of the zinc is removed, as zinc oxide and the residuum consists of a mass of manganese and iron oxides. This is used for the manufacture of spiegeleisen and ferromanganese. The following table shows the quantity, value, and average price per ton of manganiferous zinc residuum produced in 1905, 1906, and 1907:

Production of manganiferous zinc residuum in the United States 1905–1907, in long tons.

Year.	Quantity.	Value.	Average price per ton.
1905	90,289	$90,289	$1.00
1906	93,461	93,461	1.00
1907	93,413	280,239	3.00
Total	277,163	463,989	1.67

The following table gives the production of manganiferous zinc residuum in the United States as far as known:

Production of manganiferous residuum from zinc roasting in the United States, 1889–1907, in long tons.[a]

Year.	Quantity.	Year.	Quantity.
1889	43, 648	1900	87, 110
1890	48, 560	1901	52, 311
1891	38, 228	1902	65, 246
1892	31, 859	1903	73, 264
1893	37, 512	1904	68, 189
1894	26, 981	1905	90, 289
1895	43, 249	1906	93, 461
1896	44, 935	1907	93, 413
1897	33, 924		
1898	48, 502	Total	1, 085, 691
1899	65, 010		

[a] The manufacture of spiegeleisen from manganiferous residuum was begun in 1870, but there is no record of the tonnage of raw material used prior to 1889.

FERROMANGANESE AND SPIEGELEISEN.

PRODUCTION.

The total production of ferromanganese and spiegeleisen in the United States in 1907 was 339,348 long tons, of which 55,918 tons were ferromanganese and 283,430 tons were spiegeleisen. This total exceeds the production of 1906 by 38,848 tons. The production in 1906 was 300,500 long tons, of which 55,520 tons were ferromanganese and 244,980 tons were spiegeleisen. Of the total output in 1907 251,747 tons were produced in Pennsylvania and the rest in New Jersey, Maryland, Illinois, and Colorado.

The production of spiegeleisen was begun in the United States in 1870 from the manganiferous residuum of New Jersey zinc oxide works, but the quantity manufactured the first two years has not been recorded. The following table gives the total quantity of ferromanganese and spiegeleisen produced in the United States from 1872 to 1907, inclusive. As ferromanganese and spiegeleisen are included under the production of pig iron, no separate value is assigned to them in this table.

Production of spiegeleisen and ferromanganese in the United States, 1872–1907, in long tons.

Year.	Quantity.	Year.	Quantity.
1872	4,072	1891	127,766
1873	3,930	1892	179,131
1874	4,070	1893	81,118
1875	6,993	1894	120,180
1876	5,907	1895	171,724
1877	7,897	1896	131,940
1878	9,530	1897	173,695
1879	12,438	1898	213,769
1880	17,503	1899	219,768
1881	18,827	1900	255,977
1882	19,610	1901	291,461
1883	21,941	1902	212,981
1884	30,262	1903	192,661
1885	30,956	1904	219,446
1886	42,841	1905	289,983
1887	42,498	1906	300,500
1888	48,901	1907	339,348
1889	76,628		
1890	133,180	Total	4,059,432

IMPORTS.

Ferromanganese and spiegeleisen are imported at the same rate of duty as ordinary pig iron; i. e., at $4 per ton. The following table gives the quantity of ferromanganese and spiegeleisen imported into the United States, by fiscal years, as far as has been recorded:

Imports of ferromanganese and spiegeleisen into the United States during fiscal years ending June 30, 1884–1907, in long tons.[a]

Year ending June 30—	Ferromanganese.	Spiegeleisen.	Total.
1884	94,210		94,210
1885	65,406		65,406
1886	99,426		99,426
1887	150,205		150,205
1888	108,973		108,973
1889	93,032		93,032
1890	108,771		108,771
1891	54,239		54,239
1892	55,080		55,080
1893	49,157		49,157
1894	11,579		11,579
1895	8,127		8,127
1896	66,608		66,608
1897	11,301		11,301
1898	6,346	10,108	16,454
1899	10,392	3,615	14,007
1900	10,684	13,675	24,359
1901	8,995	16,308	25,303
1902	37,618	31,416	69,034
1903	53,121	122,566	175,687
1904	23,903	50,620	74,523
1905	41,166	22,443	63,609
1906	62,064	88,224	150,288
1907	94,543	82,423	176,966
Total			1,766,344

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[a] Imports prior to 1884 not recorded. Estimated tonnage imported yearly during the seventies is about 20,000 to 30,000 tons.

The following table gives the importation of spiegeleisen and ferromanganese into the United States from 1903 to 1907, by calendar years:

Ferromanganese and spiegeleisen imported and entered for consumption, 1903–1907, in long tons.

Year.	Ferromanganese.		Spiegeleisen.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	41,519	$1,699,666	122,015	$2,709,317	163,534	$4,408,983
1904	21,813	707,037	4,623	132,461	26,436	839,498
1905	52,841	1,884,651	55,457	1,336,104	108,298	3,220,755
1906	84,359	4,953,644	103,268	2,942,940	187,627	7,896,584
1907	87,400	5,354,656	48,994	1,399,381	136,394	6,754,037

GOLD AND SILVER.

By WALDEMAR LINDGREN AND H. D. McCASKEY.

PRODUCTION IN THE UNITED STATES.

The production of gold and silver in the United States from domestic ores in 1907 is shown in the following table in distribution by States and Territories:

Approximate distribution by producing States and Territories of the product of gold and silver in the United States for the calendar year 1907, in fine ounces.[a]

State or Territory.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Commercial value.
Alabama	1,325	$27,400	600	$400
Alaska	894,424	18,489,400	179,300	118,300
Arizona	128,871	2,664,000	2,903,100	1,916,000
California	815,288	16,853,500	1,590,000	1,049,400
Colorado	1,010,921	20,897,600	11,495,400	7,587,000
Georgia	3,135	64,800	700	500
Idaho	60,754	1,255,900	7,888,400	5,206,300
Illinois			2,900	1,900
Michigan			331,300	218,700
Missouri			25,300	16,700
Montana	167,987	3,472,600	11,129,600	7,345,500
Nevada	745,507	15,411,000	8,280,500	5,465,100
New Mexico	15,964	330,000	599,500	395,700
North Carolina	3,807	78,700	25,200	16,600
Oregon	59,124	1,222,200	96,000	63,400
Philippine Islands	3,130	64,700	100	100
Porto Rico	58	1,200		
South Carolina	2,811	58,100	100	100
South Dakota	200,185	4,138,200	106,600	70,400
Tennessee	184	3,800	58,300	38,500
Texas	48	1,000	305,300	201,500
Utah	247,758	5,121,600	11,406,900	7,528,500
Vermont			3,800	2,500
Virginia	402	8,300	200	100
Washington	12,689	262,300	84,000	55,400
Wyoming	455	9,400	1,600	1,100
Total	4,374,827	90,435,700	56,514,700	37,299,700

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[a] Gold value, $20.671834625323 per fine ounce. Silver value, 66 cents per fine ounce.

The figures in this table are the result of conference and adjustment between the Bureau of the Mint and the Geological Survey, and are accepted as final by the two bureaus. The basis for this table are data collected by the Bureau of the Mint of bullion deposits in the United States mints and assay offices and by statements from the smelting and refining establishments; the distribution by States is, moreover, checked and verified by the data collected by the Geological Survey directly from the producing mines. The table is derived from three items: (1) The unrefined domestic gold and silver deposited in the United States mints and assay offices; (2) the domestic gold and silver in fine bars reported by the private refineries; (3) the unrefined domestic gold and silver contained in ores, copper matte, etc., exported for reduction. The last is an item of small relative importance.

The gains and losses in the production of the various States and Territories, compared with the production of 1906, are shown in the following table:

Increase (+) or decrease (—) in production of precious metals in the United States in 1907, by States and Territories, in fine ounces.

State or Territory.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Commercial value.
Alabama	+ 188	+ $3,900	+ 500	+ $332
Alaska	−139,113	−2,875,700	− 24,200	− 19,447
Arizona	− 4,020	− 83,100	— 66,100	— 93,822
California	— 95,753	—1,979,400	+ 72,500	+ 22,220
Colorado	— 98,531	−2,036,800	− 952,000	− 838,520
Georgia	+ 1,989	+ 41,100	+ 400	+ 297
Idaho	+ 10,652	+ 220,200	− 947,800	− 774,835
Illinois			+ 2,900	+ 1,900
Michigan			+ 145,200	+ 92,731
Missouri			− 6,000	− 4,487
Montana	— 50,765	−1,049,400	−1,410,700	−1,142,904
Nevada	+296,655	+6,132,400	+3,072,900	+1,940,128
New Mexico	+ 3,087	+ 63,800	+ 146,100	+ 88,798
North Carolina	− 590	− 12,200	+ 500	− 119
Oregon	− 4,736	− 97,900	+ 5,300	+ 2,006
Philippine Islands	+ 3,130	+ 64,700	+ 100	+ 100
Porto Rico	+ 58	+ 1,200		
South Carolina	− 798	− 16,500		+ 32
South Dakota	−119,327	−2,466,700	− 48,600	− 34,653
Tennessee	+ 145	+ 3,000	+ 32,700	+ 21,172
Texas	− 116	− 2,400	+ 27,900	+ 13,731
Utah	− 450	− 9,300	− 101,100	— 261,150
Vermont			+ 3,800	+ 2,500
Virginia	− 96	− 2,000	+ 100	+ 32
Washington	+ 7,706	+ 159,300	+ 41,900	+ 26,903
Wyoming	+ 179	+ 3,700	+ 500	+ 355
Total	−190,506	−3,938,100	− 3,200	− 956,700

The total production of gold in 1907 was 4,374,827 fine ounces, valued at $90,435,700. This is a decrease compared with the production of 1906 of 190,506 fine ounces, corresponding to $3,938,100. Out of 22 States and Territories contributing to the total gold output 12 showed decreases in production in 1907. The greatest losses were shown by Alaska, $2,875,700; South Dakota, $2,466,700; Colorado, $2,036,800; California, $1,979,400; and Montana, $1,049,400. In no other case did the loss reach $100,000. Ten States and Territories increased their production of gold in 1907. The only one of these which is of great importance is Nevada, in which State the increase was $6,132,400, a strikingly large amount which almost counterbalanced the losses in California, Colorado, and South Dakota. Idaho increased its output by $220,200, and Washington by $159,300; but in no other States did the increase reach $100,000.

The production of silver in 1907 in the United States amounted to 56,514,700 fine ounces, with a commercial value of $37,299,700. This shows a decrease in quantity over the production of 1906 of 3,200 fine ounces but a decrease in value of $956,700. The production was contributed by 24 States and Territories. Of these only 8 showed a decrease as compared with the production of 1906. The greatest losses were shown in Montana, 1,410,700 fine ounces; Colorado, 952,000 fine ounces; Idaho, 947,800 fine ounces; and Utah, 101,100 fine ounces. In no other case did the loss reach 70,000 fine ounces. In 16 States and Territories an increase in the production of silver was reported, as compared with 1906. By far the greatest gains were reported from Nevada, which exceeded its output for 1906 by 3,072,900 fine ounces. An increase of 146,100 fine ounces was shown in New Mexico; in Michigan the gain was 145,200 fine ounces. In no other States did the gain reach 80,000 fine ounces.

During the first part of the year all branches of mining which participated in the production of gold and silver were in a flourishing condition. Not only were the mines in general operation, but extensive prospecting work was in progress in many regions of the Western States. The decline in the price of copper in the later part of the summer checked these operations to some extent, and in October, as a result of the general financial panic and the lack of ready money, many smelting works and mines were forced to suspend operations up to the end of the year. Thus, in the last quarter of the year the production of gold and silver ore was greatly reduced. This reduction affected ores treated by smelting considerably more than the quartzose ores, for the gold and silver mills were, as a rule, less embarrassed than the smelters, which operate on a large scale and must carry a great stock of ore on hand.

These adverse conditions reduced the output of the refineries to a much smaller degree than that of the mines, for the reason that gold and silver are not as a rule refined from lead and copper bullion until two, three, or even four months after the ore has been extracted. Therefore, the true state of the industry in 1907 is much more clearly reflected in the reports from the mines than in those from the refineries.

The financial conditions were, however, not the only causes which reduced the output of the precious metals. In Alaska strikes diminished the output from Fairbanks and from the Treadwell mines. In Colorado the loss by fire of a large mill checked the production of Cripple Creek, although the output of that camp has been declining for several years, due to the exhaustion of the ore bodies above the present drainage tunnel. In South Dakota a disastrous fire in the Homestake mine and a strike in other parts of the district were the principal causes of the unusually low production. On the other hand, newly discovered ore bodies at Goldfield and Tonopah in Nevada yielded heavily in gold and silver and brought the total for the State up to $15,411,000 in gold and 8,280,500 fine ounces of silver, figures which had not been attained in that State since the days of the Comstock bonanzas.

PRODUCTION OF GOLD AND SILVER IN UNITED STATES SINCE 1880.

The following table, from the report of the Director of the Mint on the production of gold and silver, shows the quantity and value of these metals produced in the United States since 1880:

Production of gold and silver in the United States from 1880 to 1907, inclusive, in fine ounces.

Year.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Commercial value.
1880	1,741,500	$36,000,000	30,318,700	$34,717,000
1881	1,678,612	34,700,000	33,257,800	37,657,500
1882	1,572,187	32,500,000	36,196,900	41,105,900
1883	1,451,250	30,000,000	35,732,800	39,618,400
1884	1,489,950	30,800,000	37,743,800	41,921,300
1885	1,538,373	31,801,000	39,909,400	42,503,500
1886	1,686,788	34,869,000	39,694,000	39,482,400
1887	1,603,049	33,136,000	41,721,600	40,887,200
1888	1,604,478	33,167,500	45,792,700	43,045,100
1889	1,594,775	32,967,000	50,094,500	46,838,400
1890	1,588,877	32,845,000	54,516,300	57,242,100
1891	1,604,840	33,175,000	58,330,000	57,630,000
1892	1,597,098	33,015,000	63,500,000	55,662,500
1893	1,739,323	35,955,000	60,000,000	46,800,000
1894	1,910,813	39,500,000	49,500,000	31,422,100
1895	2,254,760	46,610,000	55,727,000	36,445,500
1896	2,568,132	53,088,000	58,834,800	39,654,600
1897	2,774,935	57,363,000	53,860,000	32,316,000
1898	3,118,398	64,463,000	54,438,000	32,118,400
1899	3,437,210	71,053,400	54,764,500	32,858,700
1900	3,829,897	79,171,000	57,647,000	35,741,100
1901	3,805,500	78,666,700	55,214,000	33,128,400
1902	3,870,000	80,000,000	55,500,000	29,415,000
1903	3,560,000	73,591,700	54,300,000	29,322,000
1904	3,892,480	80,464,700	57,682,800	33,456,000
1905	4,265,742	88,180,700	56,101,600	34,222,000
1906	4,565,333	94,373,800	56,517,900	38,256,400
1907	4,374,827	90,435,700	56,514,700	37,299,700
Total	70,719,127	1,461,892,200	1,403,410,800	1,100,767,200

According to tables published by the Director of the Mint the total production of gold and silver in the United States from 1792 to 1907, inclusive, is as follows:

Production of gold and silver in the United States, 1792–1907, by periods, in fine ounces.

[The estimate for 1792–1873 is by R. W. Raymond, commissioner, and since by the Director of the Mint.]

Years.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Commercial value.
1792–1847	1,187,170	$24,537,000	309,500	$404,50
1848–1872	58,279,778	1,204,750,000	118,568,200	157,749,90
1873–1907	84,258,891	1,741,784,000	1,611,830,500	1,351,841,60
Total	143,725,839	2,971,071,000	1,730,708,200	1,509,996,00

MINES REPORT.

METHOD OF COLLECTING STATISTICS.

It should be distinctly understood that the table on page 3 contains the figures of the production of gold and silver which are accepted as final by the Geological Survey, inasmuch as they record in the main the quantities of these metals which were actually produced during the calendar year. It is difficult to trace the refined metals back to the States where the ore was produced, and it is still more difficult to trace them back to the producing counties and districts. In order, therefore, to ascertain the state of the mining industry in each mining camp, the Geological Survey asks the owners of each mining property to report the amount of gold and silver, as well as that of other metals produced. Tabulated in proper form, these replies form the basis of this mines report.

The Mint Bureau records the production of the precious metals from gold bullion deposits in United States mints and assay offices, from the fine bars reported by the refineries, and from the gold and silver contained in ores and metallurgical products exported for reduction.

The statistics of gold and silver collected from the mines by the Geological Survey are obtained from the following 4 items: 1. Gold and silver in placer bullion produced during calendar year. 2. Gold and silver in mill bullion produced in mill of company during calendar year. 3. Gold and silver in base bullion, matte, etc. (by assay value), produced in smelter of company during calendar year. 4. Gold and silver in crude ore and concentrates (by assay value) shipped to custom works in calendar year.

The first item needs no explanation. The second and third items cover the cases of mining companies which have their own reduction works; they report the gold and silver bullion produced during the year, or the gold and silver contained in their metallurgical products sold to refineries, as they are very few smelting works owned by mining companies which also refine their base bullion. There is, as a rule, no great interval of time before the ore sent to these mills and smelters is reduced to gold and silver or base bullion, and, although there is some overlap at the beginning and close of the year, the tonnage shipped from the mine during the year corresponds with fair accuracy to the quantity of fine or base bullion or matte produced.

The greatest difficulties are found in the fourth item, comprising ores and concentrates shipped to custom works—generally smelters, more rarely mills—as a considerable interval of time, often thirty days or more, elapses before the ore reaches the works, and often much more before it is reduced and refined. It is mixed with other ores and loses its identity, and the assay value is the only guide the miner has to the quantity of metal produced. In these cases the miner is requested by the Geological Survey to give the tonnage and assay value of ores and concentrates shipped up to the end of the year.

It should be emphasized that the table of mine production does not give the contents of the ore *mined* during the year. Only the ore that is *treated* or *sold* is recorded. Neither does this report give the assay value of the total tonnage; for if this were the case the heavy losses in concentration would be disregarded, and the results would be very much larger and wholly misleading. As far as possible the report aims to give the metals recovered from the tonnage sold or treated during the year. In items 2 and 3 this is substantially correct, except for the very small refining losses. In item 4 the amount given is theoretically larger than the actual recovery of refined metals by the combined smelting and refining losses, which in the case of gold and silver are known to be very small. Practically, however, this is counterbalanced by several factors: (1) Small quantities of gold and silver are recovered from many ores, but not paid for by the smelting companies or recorded in the settlements. As a rule, payments are not made on less than 2 ounces of silver or 0.05 ounce of gold per ton. (2) Settlements are made on the basis of 95 per cent of New York price for silver and of $19 to $20 per ounce of gold. Small producers, who often report in terms of dollars alone, are very likely to give a correspondingly smaller value than the ore actually contained. The same class of producers occasionally also misunderstand the question and report net instead of gross proceeds. (3) There is always a certain small percentage of the product which can not be obtained from the miners. This includes the output of scattered individual placer workers, often aliens; some of this is estimated on the basis of mint deposits by traders and banks, but a little invariably escapes detection. There are further cases where owners of small mines decline to answer, or where the property is not continuously operated and the owner can not be found. There is, lastly, the ore and amalgam stolen by "high graders," which takes away a notable fraction of the production of mines containing rich ore. Through small assay offices or improvised chlorination plants this gold finds its way to the mints or refining works. Gold and silver from old metallurgical by-products are also apt to escape notice. Taken together the three items explained above will probably compensate for the losses in smelting and refining.

In general, the response from the mine owners is extremely gratifying and indicates that they realize that the individual returns are held strictly confidential, while they profit from an exact knowledge of the aggregate production and by correct reports of the state o the industry. Careful investigation has shown that willful misstatements are very rare, and, as already noted, the replies are more likely to be too low than too high. The only difficulty experience in obtaining returns for 1907 was in California, where a few operators, chiefly in the Mother Lode region, have refused to reply basing this refusal on the erroneous idea that their production o gold is a private matter in which the Federal Government has n concern.

COMPARISON OF MINT REPORT AND MINES REPORT.

Both of the plans outlined above (see pages 3 and 7) are admittedly open to some objections, but it may be questioned whether i would be practicable to make them wholly consistent and logica The most important difference between the two reports is that, thoug covering the same time interval, they do not quite cover the sam period of ore extraction, the mines report being as much as three or four months in advance of the mint report. The mill and placer bullion reaches mints and refineries soon after its production, and it does not require a long time to obtain it from the ore; but in smelting, and especially in custom work, several months may pass before the refined metals come on the market. Sampling, shipping, mixing, roasting, smelting, shipment to refinery, and refining—all these operations take time to perform.

The figures obtained by the two methods will agree, within certain limits of error, if the mining and smelting industries are carried on uniformly and at the same rate. But important disturbing factors may result in marked discrepancies between the two sets of figures, each one being a correct statement in itself. Especially is this so when abnormal conditions appear near the beginning or close of the calendar year. In time the discrepancies will balance if the reports are intrinsically correct.

In 1904 and 1905 the two reports agreed closely. In 1905 the refinery report gave $88,180,700 in gold and 56,101,600 ounces of silver, while the mines report recorded $88,159,881 in gold and 56,272,496 ounces of silver. In the latter half of 1906 the extremely rich ore bodies of the Goldfield camp were worked, and in the last month of the year gold-ore production from the Mohawk mine was rushed to an extraordinary degree, owing to the expiring of certain leases. At the same time, in the last months of 1906, the whole country experienced a great car shortage, resulting in a corresponding delay in ore shipment and scarcity of fuel for the smelters. This meant that smelting and refining of ore shipped in the last months of the year to custom works would take much longer than usual, and consequently that much of the gold from ores mined in 1906 would be credited to the refinery output of 1907. In a less degree these conditions obtained at all smelting centers and applied to silver as well as gold.

The financial panic of 1907, as already noted, compelled a great number of mines and smelting works in the Western States to close, while the refineries, as a rule, were enabled to continue work on stocks received earlier in the year. The result of this finds expression in a very considerable reduction of the metals as reported from the mines. On the other hand, the reports from the refineries are much higher and correspond very fairly to what would have been the normal production of the year.

The total of gold given by the mint report in 1906 is $94,373,800. The mines report has $97,219,645, an excess of $2,845,845. In 1907 the mint report shows a total of $90,435,700, while the mines report has only $87,471,136, showing an excess of $2,964,564 in the mint report. The two years, therefore, balance very closely. In Alaska the figures of the mine report for 1907 are approximately $900,000 higher than the mint report, a condition which has now occurred in three successive years. In other States where mill and placer bullion predominate in 1907 there is close agreement. In California the mines report has $16,727,928 against $16,853,500 of the mint report; in Oregon, $1,129,261 against $1,222,200; in Idaho, $1,255,911 against $1,255,900; in Colorado, $20,826,194 against $20,897,600; in South Dakota, $4,138,189 against $4,138,200. The States in which most of the ore is smelted also show close correspondence. In Arizona the mines report has $2,617,313 against $2,664,000 of the mint report; in Utah, $5,121,646 against $5,121,600. A very serious difference is shown in Nevada, where the mines report has $12,099,455 against $15,411,000 of the mint report. This difference will be discussed in greater detail on a succeeding page.

UNITS OF MEASUREMENTS.

Gold and silver are measured by the fine ounce. In the computing tables prepared by the Bureau of the Mint and the Geological Survey gold is counted as $20.671834625323 per fine ounce. The average commercial price of silver in New York in 1907 was 66 cents per fine ounce. The monthly average price of the metal fluctuated between 68.84 and 54.57 cents, the latter figure being reached in December.

The standard unit for ore production is the short ton of 2,000 pounds.

PRODUCTION OF GOLD AND SILVER REPORTED FROM THE MINES.

The following table gives the quantity and the value of gold and silver reported from the producing mines in 1907 to the officers of the United States Geological Survey. The last column in the table gives the increase or decrease in value as compared with the mines report of the preceding year as recorded in Mineral Resources for 1906.

Production of gold and silver in the United States in 1907 as reported from the mines to the United States Geological Survey, by States and Territories, in fine ounces.

State or Territory.	Gold.		Silver.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Gold, value.	Silver, quantity.
Alabama	1,256.88	$25,982	439	$290	+ $1,061	+ 31
Alaska	936,043.81	19,349,743	149,784	98,857	−2,687,051	− 16.28
Arizona	126,612 52	2,617,313	2,511,897	1,657,852	− 347,370	− 514,54
California	809,213.52	16,727,928	1,138,858	751,646	−2,004,524	− 81,78
Colorado	1,007,467.14	20,826,194	11,229,776	7,411,652	−2,384,435	− 987,05
Georgia	3,135.09	64,808	864	570	+ 33,758	+ 26
Kentucky			103	68		+ 10
Idaho	60,754.70	1,255,911	8,415,431	5,554,185	+ 106,811	− 603,38
Illinois			2,852	1,882		+ 2,8
Michigan			299,764	197,844		+ 77,5
Missouri			25,692	16,957		− 5,5
Montana	158,970.51	3,286,212	9,317,605	6,149,619	−1,182,802	−2,663,1
Nevada	585,311.14	12,099,455	7,083,603	4,675,178	+1,628,751	+ 312,9
New Hampshire			174	115		+ 1
New Mexico	15,962.88	329,982	705,544	465,659	+ 36,963	+ 214,4
North Carolina	3,976.08	82,193	21,667	14,300	+ 62	− 9,1
Oregon	54,628.00	1,129,261	86,718	57,234	− 237,639	+ 7,3
Philippines	3,859.02	79,773	83	55	+ 79,773	+
Porto Rico	58.05	1,200			+ 1,200	
South Carolina	2,649.26	54,765	124	82	− 24,194	+
South Dakota	200,184.89	4,138,189	93,895	61,971	−2,703,280	− 56,
Tennessee	185.04	3,825	58,358	38,516	− 1,013	+ 2,
Texas	.44	9	303,688	200,434	− 1,583	+ 1,
Utah	247,759.63	5,121,646	10,990,076	7,253,450	− 96,740	− 560,
Vermont	1.98	41	3,814	2,517	+ 41	+ 2,
Virginia	400.93	8,288	221	146	− 6,544	−
Washington	12,532.70	259,074	55,359	36,537	+ 37,426	+ 9,
Wyoming	452.02	9,344	3,715	2,452	+ 2,823	+ 3,
Total	4,231,416.21	87,471,136	52,500,104	34,650,068	−9,748,506	−4,862,

Compared with the mines report for 1906 this table indicates a decrease of $9,748,506 in gold and of 4,862,350 fine ounces of silver. Twenty-three States and Territories contributed to the production of gold. The rank of the principal producers remained nearly as in 1906 and is as follows: Colorado, Alaska, California, Nevada, Utah, South Dakota, Montana, and Arizona. The only change consists in an exchange of places between Montana and South Dakota. Vermont appeared for the first time in many years as a producer of gold. The Philippines and Porto Rico were in 1907 added to the list. Twenty-seven States and Territories participated in the production of silver; the rank of the principal producing States was somewhat changed from 1906 and now is as follows: Colorado, Utah, Montana, Idaho, Nevada, and Arizona.

Alaska.—The gold production of Alaska was less in 1907 than in 1906 by $2,687,051, the production for 1907 being $19,349,743. This decrease was largely due to labor troubles at Fairbanks and also in some degree at Juneau and on the Seward Peninsula. The production was divided approximately as follows: From the Pacific Coastal belt, $3,100,000; from the Copper River and Cook Inlet region, $200,000; from the Yukon Basin, $9,100,000; and from the Seward Peninsula, $7,000,000. The copper mines of Prince of Wales Island and Prince William Sound contributed $93,858 in gold. New discoveries were made in the outlying districts south of Fairbanks. The Tenderfoot district yielded $225,000. The production at Fairbanks was approximately $8,000,000. The gold in the third beach at Nome is becoming exhausted and the mining will have to depend on creek and bench gravels. In the Forty-mile district 3 dredges are installed; 1 dredge is working on the Solomon River, Seward Peninsula; and examinations have been made to ascertain the feasibility of further dredging on the Peninsula and at Fairbanks. Owing to an exceptionally dry season a further decrease in the output is not unlikely for 1908.

The production of silver was nominal, 149,784 fine ounces, in 1907, most of it being derived from the small percentage of this metal which is contained in placer gold. The copper ores of the Pacific coast belt yielded 52,056 fine ounces of silver.

Arizona.—The gold production of Arizona amounted to $2,617,313, a decrease of $347,370. A large part of this came from Yavapai County. Mohave, Cochise, and Yuma counties were next in rank. The leading producing mines were the Goldroad, in Mohave County; the King of Arizona, in Yuma County; the Gladstone, in Yavapai County; and the United Verde and the Congress mines in Yavapai, County. Forty-nine per cent of the total yield was obtained from siliceous ores in quartz mills, the larger part of the remainder being obtained from copper ores. The placers yielded $44,891, partly from dry washings. Toward the end of the year the industry was interfered with on account of financial conditions, but to a less degree than in other States. It is expected that the production for 1908 will remain at about the same figures as in 1907.

Silver was produced in Arizona to the amount of 2,511,897 fine ounces, a decrease of 369,862 ounces. Cochise County, which contains the great copper mines of Bisbee and the silver-lead-gold mines of Tombstone, leads in the production of silver, having yielded in

1907, 1,411,301 fine ounces. Yavapai County is the next in rank. The principal producers, each of them yielding over 300,000 ounces, are the Tombstone Consolidated, the United Verde, the Copper Queen, and the Commonwealth mines. The silver obtained from copper ores in 1907 amounted to 1,416,964 ounces, and the siliceous ores yielded 976,600 ounces. The output for 1908 is not expected to be materially smaller than that of 1907.

California.—The output of gold in California in 1907 was $16,727,928, a decrease of $2,004,524 from 1906. The larger part of this decrease was due to labor troubles in the Mother Lode region, which closed many mines for several months. The placer production also showed a decrease in all its branches, including dredging; the reason for the falling off in the dredge production is found in disastrous floods, which wrecked several dredges. The placer mines of California yielded $6,840,695, which was $535,230 less than in 1906. Of this, $5,065,437 was obtained from dredging operations. The rank of the most important counties is as follows: Butte, $2,786,840, this amount being derived almost exclusively from dredging operations; Nevada, $2,162,083, chiefly from the quartz mines at Grass Valley; Amador, $2,116,182, almost entirely from the Mother Lode mines; Yuba, $1,766,770, wholly from dredging and a great increase over 1906; and Calaveras, $1,097,974, chiefly from the mines of the Mother Lode. Sacramento, Shasta, Tuolumne, and Kern counties produced each from $800,000 to $900,000. Placer, Sierra, and Trinity counties each yielded about $500,000. The copper ores of the State yielded $339,152 in gold. Only small amounts of gold are obtained from lead and zinc ores. The production for 1908 will probably be maintained at about the same figure as that of 1907.

The production of silver was, as usual, small. In 1907 the amount recorded was 1,138,858 fine ounces, a decrease of 81,783 fine ounces. To this amount Shasta County contributed 560,926 fine ounces, practically all from copper ores; Kern County, 130,353, mostly from quartzose ores. San Bernardino, Calaveras, Inyo, and Mono counties each yielded amounts ranging from 123,000 to 45,000 fine ounces.

Colorado.—Colorado produced $20,826,194 in gold, a decrease of $2,384,435 compared with 1906. The decrease of the yield of 1906 as compared with 1905 was $1,813,344. The mining industry of Colorado suffered severely from the financial conditions at the end of 1907, as well as from the burning of an important mill belonging to the Golden Cycle Company, at Colorado Springs. The rank of the counties stands at present as follows: Teller, San Miguel, Ouray, Lake, San Juan, Gilpin, Clear Creek, and Park, the production of the latter county being $513,000. In most counties reduced production is reported. An increase in the output is noted from Ouray, San Juan, and Park counties. Cripple Creek (Teller County) yielded $10,913,687 in gold, a decrease of over $3,000,000 as compared with the output of 1906. The tonnage in that district was reduced to 451,082 short tons. The San Juan country yielded a total of $6,270,216, a considerable increase over 1906, due to the operation of the rebuilt Camp Bird mill. To this total production Ouray County contributed $2,415,049, San Miguel County $2,467,516, and San Juan County $967,732. The three counties of Gilpin, Clear Creek, and Boulder produced together $1,623,042, of which $938,488 is to be credited to Gilpin County. The placer output was $100,830, nearly double that of 1906, the increase being traceable to Chaffee, Clear Creek, and Eagle counties. Siliceous and dry ores yielded 91 per cent of the total gold production. The tonnage of copper ore was small. The outlook for 1908 indicates a maintenance of the gold production at approximately the same figures.

Colorado produced 11,229,776 fine ounces of silver, a decrease of 987,054 fine ounces. The principal reason for this lessened yield is to be found in the closing of several mines toward the end of 1907. The smelting ores of Lake County (Leadville) led, as usual, in the output of silver and produced in 1907 4,154,913 ounces, an increase of about 250,000 ounces over 1906. Pitkin County (Aspen) reported 1,719,446 ounces, a decrease of over 400,000 ounces as compared with 1906. Mineral County (Creede) produced 870,456 ounces, a decrease of about 250,000 ounces. The three districts of Leadville, Aspen, and Creede yielded together 6,744,815 ounces. The San Juan country gave a total of 3,233,535 fine ounces, to which San Miguel County (Telluride) contributed 1,438,299 ounces and San Juan County (Silverton) 1,175,176 ounces. The Gilpin group of counties reported 751,191 ounces, of which 518,364 came from Clear Creek County. Ores classed as siliceous, which include a considerable part of the Leadville ores, gave 7,409,999 ounces, or 66 per cent of the output of the State. The lead ores proper yielded 2,357,981 ounces. A further decrease in the production of silver is probable in 1908.

Idaho.—The mines of Idaho yielded $1,255,911 in gold, an increase of $106,811. The bulk of the gold came from the siliceous ores of Owyhee County (Silver City) and amounted to $355,919. Boise County came next with a production of $235,276, derived in large part from the placers of the Idaho Basin. Custer County produced $175,869. The placers of the State yielded $353,481, a slight increase over 1906. Siliceous ores predominate in the gold-producing counties. Only a small quantity of gold was obtained from copper ores. About $72,000 in gold were obtained from dredging.

Of silver 8,415,451 ounces were produced, a decrease of 603,384 ounces; of this total, 7,266,862 ounces came from lead ores of the Cœur d'Alene district, which is a small decrease as compared with 1906. Owyhee County added 793,942 ounces from siliceous ores of Silver City, and Blaine County (Wood River district) 170,367 ounces from lead ores.

Michigan.—The mines of Michigan yielded 299,764 ounces of silver, an increase of 77,542 ounces as compared with the output of 1906. This silver was produced by 10 companies operating copper mines and was chiefly derived from electrolytic refining of Lake copper. A small part of the output came, however, from "pickings" or metallic lumps saved in the stamp batteries. Amygdaloid ores contributed about 95 per cent of the production, the remainder coming from the conglomerate ores. The yield per ton of ore averaged 0.03 ounce of silver and from 1 to 2 per cent of copper.

Missouri.—A small quantity of silver is annually recovered from the lead of southeastern Missouri. The silver content is only from 1 ounce to 1¼ ounces per ton of lead. In 1907 25,692 ounces were obtained.

Montana.—The gold production of Montana in 1907 amounted to $3,286,212, a decrease of $1,182,802 from the output of 1906. This decrease was largely due to the suspension of operations of many mines at Butte, as well as to the reduced yield of the cyaniding ores in Fergus County. Gains in other counties offset a part of this loss. A total of about $349,000 was recovered from placers, against $522,000 in 1906. Most of the loss was experienced in Madison County (Alder Gulch). Silverbow County (Butte) still leads with an output of $710,500 in gold. The output from Fergus County is diminished, but still amounts to $647,000 from deep mines and placers. The output for 1908 is not likely greatly to exceed that of 1907.

The production of silver was 9,317,605 ounces, a decrease of 2,663,100 ounces from 1906. This decrease was almost entirely due to the curtailing of the copper production of Butte. The production of Silverbow County (Butte) was 7,516,659 ounces. Jefferson County added 775,159 ounces, chiefly from silver-lead ores. The output of Granite County was somewhat larger than in 1906 and amounted to 456,096 ounces. No increase in the production of the State is to be expected in 1908.

Nevada.—Nevada mines yielded $12,099,455 in gold, an increase of $1,628,751 over 1906. The larger part of this was derived from the Goldfield district, the amount being $8,408,396, or 70 per cent of the total. This was obtained from 101,136 short tons of ore. The Tonopah district produced $1,183,628, a decrease of a little over $100,000 from 1906. This was obtained from 214,608 tons of ore. A little over $10,000,000 in gold was produced in Esmeralda and Nye counties, which contain these two districts. Lincoln County was third, with an output of $929,775, largely from the Delamar district. The Comstock mines contributed about $250,000. The output of Eureka and Lander counties was considerably increased. The State suffered from scarcity of labor in the first part of the year, and during the last three months many mines were closed down. The year is marked by the beginning of milling operations on a large scale both at Goldfield and at Tonopah.

It remains to explain in a few words the differences between the statements of the mint report and of the mines report in case of Nevada gold. In 1906 the mint report had $9,278,600 and the mines report $10,470,704. The figures of the mines production were too large for 1906 by the sum of $1,730,000, the contents of a shipment of ore that had not actually been made until January. The correct amount should, therefore, have been $8,740,704, representing the output of the mines in 1906. In 1907 the mint report has $15,411,000, and the mines report $12,099,455; to the latter should, therefore, be added $1,730,000 as an amount erroneously credited to 1906, and, moreover, not less than $1,000,000 from "high grade," or stolen ore, which, as asserted in the mines report for 1906 was taken from the Goldfield mines, and which found its way to mints, assay offices, and refineries during 1907. These corrections would give a total of $14,829,455, which closely corresponds with the figures of the mint report. The gold production of Nevada will probably be maintained for 1908 at figures similar to those of 1907.

The silver output was 7,083,603 fine ounces, an increase of 312,992 ounces. To this amount Tonopah contributed 5,370,891 ounces, a decrease of 327,037 ounces. The output was derived from 214,608 tons of ore. Churchill County was next in rank, with 655,500 ounces, chiefly obtained from the Fairview and Wonder districts. The Comstock mines in Storey County yielded approximately 163,000 ounces. The State of Nevada is likely to produce somewhat more silver in 1908 than in 1907. A difference exists here, too, in the figures of the mint report and of the mines report. The former gives for 1907, 8,280,500 ounces of silver for Nevada, while the mines report only has 7,083,603 ounces, an excess of the mint report of approximately 1,200,000 ounces. This is probably accounted for by the fact that many smelters were well stocked with Nevada ores at the end of 1907 and kept running for a considerable time after the mines had been temporarily closed.

New Mexico.—The gold produced by the New Mexico mines was valued at $329,982, an increase of $36,963. Grant County led as usual, owing to the gold produced at the mines of Pinos Altos, but the county is now closely followed by Socorro, the mines in the Mogollon having largely increased their yield. No other county reached a production of $100,000, Lincoln County reporting the highest production, $41,417. The total placer production was only about $20,000. Most of this came from Colfax County, the production of which has, however, greatly decreased in the last few years. The siliceous ores yielded about $240,000, the copper ores approximately $46,000.

The production of silver amounted to 705,544 fine ounces, an increase of 214,417 ounces. The leading counties were Socorro, Grant, and Dona Ana. The mines of the Mogollon district nearly doubled their production. The greatly increased production of copper had little influence on the yield of silver. From siliceous ores 542,252 ounces were obtained, chiefly from Socorro and Grant counties. From the production of copper ores 115,323 ounces were obtained, to which Grant, Santa Fe, and Socorro contributed the largest portion.

New Hampshire.—A small production of silver was reported from lead ores mined in New Hampshire.

Oregon.—The production of gold in Oregon amounted to $1,129,261, a decrease of $237,639. Of this amount $396,478 came from southwestern Oregon, and $732,783 from the districts in the northeastern part of the State. The total yield of the placers was $331,406. To this amount the southwestern placers contributed $239,942 and those of the northeastern district $91,464. Compared with the production of 1906 the southwestern placers showed a decrease of over one-third, while the placer production in the northeast nearly doubled. Baker County was the largest producer of gold from siliceous ores; Josephine County had the largest output of placer gold.

The yield of silver was small in 1907, as usual, and amounted to 86,718 fine ounces. To this Baker County contributed 69,589 ounces.

South Dakota.—The mines of the Black Hills decreased their output by $2,703,280, the amount produced being $4,138,189. The year was an unfortunate one for the mining interests owing to a disastrous mine fire at the Homestake property and to strikes at other mines in the beginning of 1907. The larger part of the decrease was due to the interruption of work at the Homestake mine. No smelter was in operation in the Black Hills in 1907. The 350-ton cyanide plant of the Mogul mine was remodeled. A large increase in production is probable for 1908.

The total production of silver was 93,895 fine ounces.

Southern Appalachian States.—Alabama, Georgia, North Carolina, South Carolina, Tennessee, and Virginia yielded $239,861 in gold, an increase of $3,130 over the output of 1906. A moderate increase of production was reported in Alabama, Georgia, and North Carolina. The greatest output of $82,193 came from North Carolina; this was followed by Georgia, with $64,808; South Carolina, with $54,765; and Alabama, with $25,982. As usual siliceous ores yielded the greatest amount, principally from the Iola mine in North Carolina, the Haile mine in South Carolina, and the Hillabee mine in Alabama. The total output of placer gold was about $33,000.

Of silver 81,257 ounces were produced, a decrease of 643 ounces. The only States which have an important output of silver are Tennessee, with 58,352 ounces, and North Carolina, with 21,667 ounces. Almost the whole output of silver is derived from copper ores.

Texas.—Texas produced only a nominal amount of gold.

The yield of silver was 303,688 ounces, representing a small increase compared with 1906. The metal is chiefly derived from siliceous oxidized ores of the Shafter mine in Presidio County.

Utah.—Utah mines reported $5,121,646, a decrease of $96,740 from 1906. As in 1906, the Bingham and Tintic districts, which nearly correspond to Juab and Salt Lake counties, were the most prominent producers of gold from smelting ores, yielding, besides, silver, copper, and lead. The Tintic ores contributed 46 per cent to the gold production of the State. The Bingham ores yielded 30.5 per cent of the total, and the cyaniding ores of the Mercur district 10.85 per cent. Thus, these three districts gave 87 per cent of the gold production of the State. Bingham yielded $1,565,483 and Tintic $2,337,270 in gold. As compared with 1906 the production in Bingham district showed a slight decrease, while that of Tintic increased by $412,204. The gold mills of Tooele County yielded $555,915; the yield from the later source has decreased slowly since 1903. A small amount of placer gold was derived from the bars of the Grand and San Juan rivers. The production for 1908 will probably about equal that of 1907.

Of silver 10,990,076 ounces were reported, a decrease of 560,558 ounces. Utah is now second in rank among the silver-producing States. It is only exceeded by Colorado, which yielded 11,229,776 ounces. The bulk of the silver was derived from the lead-copper ores of Tintic, from the ores of Bingham, and from the lead ores of Park City Tintic produced 4,949,032 ounces, Park City 2,794,552 ounces, and Bingham 1,786,580 ounces. The combined production of these three districts was 9,530,164 ounces. All three districts decreased their output of silver very decidedly. The greatest decrease of 960,787 ounces took place in the Park City district.

Vermont.—As in 1906 Vermont contributed a small output of silver derived from the copper mines in Orange County.

Washington.—The mines of this State reported $259,074 in gold, an increase of $37,426 as compared with 1906. The main part of the production was divided between the Pierre Lake district in Stevens County, and the Monte Cristo mines in Snohomish County. There was little activity shown in the Republic district and in the Mount Baker mines, both very productive in former years. Stevens County led with a production of about $149,000. The output of placer gold was $21,860, chiefly derived from Whatcom and Kittitas counties. Only a small amount of gold was produced from lead and copper ores.

As to silver, the production was insignificant, amounting only to 55,359 ounces. The largest part of this was derived from Snohomish County.

Wyoming.—The production of gold from Wyoming amounted only to $9,344, an increase of $2,823 compared with 1906. Most of this gold is derived from copper ores of the Encampment district. Only a small quantity comes from placers and siliceous ores.

Philippine Islands.—Although gold mining has been carried on in the Philippine Islands for several hundred years, exact records of production have not been kept. The aggregate value was undoubtedly great. Since the American occupation of the islands there has been much prospecting and considerable development of gold and copper deposits, principally of the former, but the production until 1907 was chiefly confined to placer washing and gopher mining for gold in the hands of the non-Christian tribes of the hills. This production by the natives of the islands probably averaged about 1,500 fine ounces of gold, valued at about $31,000, each year during the nine years ending with 1907. The total production by Americans and Europeans from 1898 to 1906, inclusive, probably did not exceed 600 fine ounces, about $12,400 in value. Preparations that had been in the making for several years by American miners began to bear their first real fruits in 1907, however, and for that year the Division of Mines of the Bureau of Science, at Manila, have published some statistics, from which the following figures are taken.

The total production of gold in the Philippine Islands for 1907 is given by the Division of Mines as 4,540 crude ounces.[a] At the average fineness of 0.850 this would represent 3,859 fine ounces, valued at $79,773. The production of silver is given as 83 fine ounces,[a] valued at $55. The total value of production of precious metals in the Philippines would, therefore, amount to $79,828.

Although occurrences of gold are known in many islands of the group, the production of 1907 is to be credited to but two of them, Luzon and Masbate. In the former are two producing provinces, Benguet, in the northern part, and Ambos Camarines, in the southeastern part, on the Pacific coast. Masbate Island, to the southwest of Luzon, forms a portion of the province of Sorsogon.

For centuries the Igorots of Lepanto and Benguet have been mining gold, washing it from the streams or recovering it by impounding water in the hills and releasing it in floods over decomposed surface material, in this way securing additional auriferous gravel, and at the same time exposing the rich and narrow veins which they worked to limited depths underground. The rich vein material thus obtained contained free gold which was recovered after the ore was crushed in crude stone mortars and washed by hand. The Igorots and later the Spaniards worked also quite extensively the copper ores at Mancayan, in southern Lepanto, near the northern boundary of Benguet. For a number of years considerable quantities of copper were recovered, which, however, did not add to the output of precious metals, although the ores, which are mixed sulphides, arsenides, and antimonides, sometimes carry as much as $5 to the ton in gold, particularly in the pyrite. Since the American occupation production of gold by the Igorots has continued. In 1907, 2 triple-discharge Hendy stamp mills, with cyanide equipment, on the claims of the Benguet Consolidated Mining Company, near Baguio, began production from siliceous ores. In the Camarines, particularly at Paracale and Mambulao, European interests at one time did extensive underground work and erected modern mills. Their work was interrupted by the native insurrection of 1896 and has only been resumed in a small way by American miners in the last few years. The ores are partly sulphides and partly oxidized siliceous ores. There has been no production from the mines in the last twelve years. Antedating the Spanish conquest of the islands, the natives of the Camarines worked the placers of these districts and have ever since made an annual production, which was of considerable importance in the early years. This led to investigations by representatives of American and New Zealand capital, and in 1907 a New Zealand dredge was installed, which has since been working with most promising results, contributing largely to the output for 1907. In the northern part of Masbate, at Aroroy, are many old abandoned gold mines of the Spanish régime, or of earlier times, and these have been actively prospected and partly worked by American miners. The ores are siliceous and oxidized to water level, where they give way to gold-bearing pyrite. Several stamp mills were erected by Americans, and one of them was run for several months in treating an old dump carrying good values in free gold. Examination of the streams of this district led to the installation of 2 modern American dredges, one of which has since shut down. The total production to date from Masbate in the last ten years has been small.

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[a] The Mineral Resources of the Philippine Islands, with a statement of the production of commercial mineral products during the year 1907. Issued by Warren D. Smith, Division of Mines, Bureau of Science, Manila, 1908.

Considerable gold is mined by natives in Mindanao in placer workings each year, but reliable estimates of the output are not available.

Silver ores occur rarely in the Philippines, the one notable occurrence having been found in northern Benguet, near the Lepanto line. This is in part native silver, but the deposit has not been developed. Lead ores, carrying silver, occur in the islands of Cebu and Marinduque, but they have not been developed up to the present time.

NUMBER OF MINES, ORE PRODUCTION, AND AVERAGE VALUES.

The following table indicates the number of producing mines in 1907, divided into placer mines and deep mines. In the former mines values, generally in gold, are extracted from gravels or sands; the "deep mines" work deposits in solid rock which have not been disintegrated and sorted by erosion. The total number of mines is of course much larger than the figures given, because many properties for various reasons are idle or are being developed without having yet attained a producing stage.

It is perhaps a little difficult, especially in the case of placers, to define what constitutes a mine. In some places a fairly large aggregate output is obtained, usually through traders and storekeepers, from transient or intermittent work of wandering miners which can not be credited to separate properties.

Number of producing mines in 1907 by States and Territories.[a]

State or Territory.	Number of mines.			State or Territory.	Number of mines.		
	Placer.	Deep.	Total.		Placer.	Deep.	Total.
Alabama, Georgia, and Maryland	27	13	40	North Carolina	26	17	43
Alaska	1,250	26	1,276	Oregon	141	65	206
Arizona	44	393	437	South Carolina	5	1	6
California	618	443	1,061	South Dakota	6	30	36
Colorado	51	591	642	Tennessee		4	4
Idaho	214	145	359	Texas		4	4
Michigan		21	21	Utah	14	165	179
Montana	131	305	436	Vermont		3	3
Nevada	13	216	229	Virginia	1	6	7
New Hampshire		1	1	Washington	14	39	53
New Jersey		1	1	Wyoming	8	11	19
New Mexico	23	104	127	Total	2,586	2,604	5,190

[a] Illinois, Kentucky, Missouri, Philippines, and Porto Rico not included.

The table shows the number of gold and silver producing mines in the United States. In the States of the Rocky Mountain region and the Pacific slope practically every mine producing lead, copper, or zinc also yields the precious metals. The table, therefore, actually records the number of producers of gold, silver, copper, lead, and zinc in these Cordilleran States. It also records the gold and silver producing mines in Michigan and in the Eastern States. It has not been possible to trace the production of Illinois, Kentucky, and Missouri to individual mines.

Compared with the corresponding table for 1906 notable additions are found. The placer mines operated in 1907 are 2,586 in number, against 2,316 in 1906. The deep mines number 2,604 in 1907, against 2,114 in 1906. In Alaska 150 more placer mines were worked in 1907 than in 1906. In this Territory it has proved difficult to record all the small operations and the number is therefore, in part, an estimate. The number of deep mines which yielded production in Arizona more than doubled in 1907. Notable additions are also recorded to the producing deep mines in California and Colorado, as well as to the placers and deep mines in Idaho and Montana. The producing deep mines in Nevada increased from 143 to 216. In Oregon the number of placer mines and deep mines decreased. Thirty-nine deep mines were added to the producing list in Utah. In total number of mines Alaska ranks first, with 1,276, followed by California with 1,061, Colorado with 642, Arizona with 437, and Montana with 436. Idaho has 359 mines, while Utah and South Dakota, which both stand higher in production than Idaho, have only 179 and 36 mines, respectively.

The best guide to the development of deep mines is, however, found in the record of tonnage of ores mined, which is given in a subsequent table.

A proper classification of the western ores is very difficult on account of their complex nature and the transitions between the various classes, however they may be defined. The classification in the following table is based on the quality of the ore as mined. The ores are divided into dry or siliceous ores, which comprise the gold and silver ores proper; further into copper ores, lead ores, zinc ores, copper-lead-zinc ores, and lead-zinc ores. It is not possible to divide the dry or siliceous ores into gold ores and silver ores, for the two metals are present in them in all proportions. However, the silver ores mined exclusively for silver form a very small class and less than 100,000 tons of them were mined. Under copper ores are classed those which contain 2½ per cent or more of copper, as well as those which contain less than this amount, provided their principal value is in copper. The Lake Superior ores contain, for instance, only from 1 to 2 per cent of copper, and from the Bingham porphyry ores less than 2 per cent is also recovered. The lead ores are those which contain over 4½ per cent of lead, irrespective of their tenor in precious metals. Special divisions of mixed ores have been established. A comparatively small amount of zinc is mined as zinc ores, and these contain at least 25 per cent of that metal. Most of the argentiferous zinc ores of the Rocky Mountain States are mined as lead-zinc ores and are subsequently concentrated.

Ore production in short tons and average extraction value of gold and silver per ton in 1907, by States and Territories. [a]

State or Territory.	Dry or siliceous ores.		Copper ores.		Lead ores.		Zinc ores.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama, Georgia, and Maryland	14.887	$4.39	10,740	$0.27				
Alaska	1,209,639	2.30	98,927	1.30				
Arizona	357,005	6.47	3,191,125	.56	17,364	$6.73	31	$20.32
California	1,704.549	5.75	339,152	2.20	7,852	6.83		
Colorado	1,691,646	14.49	22,619	12.24	310,600	7.72	17,748	2.63
Idaho	93,238	13.60	136,327	3.49	1,382,399	3.30	82	.00
Michigan			9,892,214	.02				
Montana	386,240	8.24	3,719,600	1.43	14,361	24.40		
Nevada	628,501	25.00	11,100	6.65	37,337	9.86	4,342	1.17
New Mexico	46,486	13.05	164,849	.75	5,873	7.44	405	.00
North Carolina	8,421	8.09	11,261	1.64				
Oregon	103,638	8.08	7,060	2.23				
South Carolina	36,198	1.49						
South Dakota	1,471,156	2.85						
Tennessee			558,487	.07				
Texas	19,615	10.22						
Utah	280,561	3.36	1,793,084	3.09	575,880	10.02	12,251	1.78
Vermont			12,333	.31				
Virginia and New Hampshire	1,128	7.33	25,044	.002	665	.44		
Washington	27,627	9.13	14,691	1.13	2,095	2.27		
Wyoming	66	11.70	26,071	.27				
Total	8,080,601	8.27	20,034,684	.74	2,354,426	5.81	34,859	5.17

State or Territory.	Copper-lead and copper-lead-zinc ores.		Lead-zinc ores.		Total and average.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama, Georgia, and Maryland					25,627	$2.66
Alaska					1,308,566	2.22
Arizona	1,608	$0.88			3,567,133	1.19
California	40	9.90	3,060	$3.55	2,054,653	5.17
Colorado	7,841	11.72	332,674	2.42	2,383,128	11.81
Idaho			78,814	1.82	1,690,860	3.82
Michigan					9,892,214	.02
Missouri			615,441	.48	615,441	.027
Montana	28,295	6.69			4,148,496	2.19
Nevada	31,077	17.12	11,224	2.09	723,581	23.10
New Mexico			2,379	.67	219,992	3.53
North Carolina					19.682	4.40
Oregon					110,698	7.71
South Carolina					36,198	1.49
South Dakota					1,471,156	2.85
Tennessee					558,487	.07
Texas					19,615	10.22
Utah	2,920	13.48	5,000	2.89	2,669,696	4.63
Vermont					12,333	.21
Virginia and New Hampshire					26,837	.32
Washington					44,413	6.16
Wyoming					26,137	.29
Total	71,781	10.46	1,048,592	.97	31,624,943	3.08

[a] Illinois, Kentucky, Philippines, and Porto Rico not included in above table.

In all, 31,624,943 short tons of ores containing gold and silver were mined and sent to reduction establishments. This can not be directly compared with the corresponding table for 1906, because that did not contain the slightly argentiferous ores of Michigan and Missouri, which amount to a total of 10,500,000 tons in round figures. Subtracting this from the total, we have left about 21,100,000 tons, which indicate a decrease compared to the corresponding figures of 1906 of 2,100,000 tons in round numbers. A decrease of about 500,000 tons in siliceous gold ores is noted from California. The decrease in Colorado amounts to about 250,000 tons and is due to a falling off in the mining of lead-zinc ores and siliceous ores. The tonnage of Idaho remains about the same. In Montana the decrease in copper ores is very great and amounts to about 1,250,000 tons. This, of course, represents the results of the temporary suspension of the work at Butte. The tonnage of Nevada siliceous ores was increased by over 200,000 tons, representing the beginning of milling operations on a large scale at Tonopah and Goldfield. The output of South Dakota was 1,471,156 tons, a decrease of 300,000 tons. Besides Nevada, Utah is the only one of the important States which has increased its tonnage heavily. In 1907 its tonnage was 2,669,696, an increase of over 300,000 tons, largely due to the beginning of the mining of porphyry ores on a large scale at Bingham. A somewhat increased tonnage is probable for 1908. The Ely plants in Nevada will add largely to the tonnage of 1908. Their capacity is 4,000 tons per day. In tonnage the important States and Territories now rank as follows: Michigan, Montana, Arizona, Utah, Colorado, California, Idaho, South Dakota, and Alaska.

The division of the tonnage shows that the copper ores and the siliceous ores are most important with, respectively, about 10,100,000 and 8,100,000 tons (Michigan excluded). Compared with the figures of 1906, this shows a decrease of about 400,000 tons of copper ore and of nearly 1,200,000 tons of dry or siliceous ores. The lead ores also suffered a considerable loss in tonnage, amounting in all to nearly 500,000 tons. In 1907 2,354,426 tons of gold and silver-bearing lead ore were mined. The zinc ores which contain gold and silver amounted to only 34,859 tons, against 68,296 tons in 1906. A large portion of the tonnage from Tintic, Utah, has in the past been classified as copper-lead ore, but this year it has been found possible to class these either as copper ores or as lead ores.

The greatest average extracted values in gold and silver are shown by the siliceous ores, $8.27 per ton. They vary from $25 per ton in Nevada, $14.49 per ton in Colorado, $13.60 in Idaho, to lower figures like $6.47 in Arizona, $5.75 in California, $2.85 in South Dakota, $2.30 in Alaska, and to the minimum of $1.49 per ton in South Carolina.

The copper ores are very much poorer in gold and silver. The highest values of $12.24 and $6.65 per ton are found in Colorado and Nevada. In the copper-producing States proper the values per ton are much lower: Utah, $3.09; Montana, $1.43, and Arizona 56 cents.

The lead ores average $5.81 per ton, much of the value being in silver. The lead ores of Montana appear to be the richest, averaging $24.40 in gold and silver. The lead ores of Utah, chiefly from Park City, Bingham, and Tintic districts, average somewhat over $10 per ton in gold and silver. The lowest values are obtained from Idaho, where the average is $3.10.

The zinc ores and the lead-zinc ores rarely contain more than 3 or 4 ounces of silver per ton and yield practically no gold.

Tables showing the extent of concentration will be found in many of the state reports, but it is not yet possible to compute a general table illustrating this for all of the Western States.

The first eight months of 1907 were most prosperous for the mining industry. High prices for the metals continued and development work was in progress in all districts. The scarcity of labor, however, continued and its efficiency in many places decreased. Strikes interfered with the work in Alaska, California, and South Dakota. The freight congestion on the railroads of the previous year was somewhat relieved. A number of smelting works were built or projected in Arizona, Utah, Idaho, and Washington. Great mills were built and put in operation in western Nevada at Goldfield, Tonopah, Bullfrog, and other places. Concentrating mills on a very large scale were built for the great low-grade deposits at Ely, Nev., and Bingham, Utah. It is regrettable that such general activity in mining is always accompanied by the organization of a great number of more or less fraudulent enterprises. The three last months stand in strong contrast to the rest of the year. The financial difficulties of October led to the closing of a great number of smelters and mines throughout the West, but particularly in Montana, Utah, and Arizona. In addition a strike interfered with the work at Goldfield during the end of the year. Little relief from these conditions was experienced up to the end of the year.

DISTRIBUTION OF THE GOLD PRODUCT OF 1907.

The following table shows the source of gold in the United States in 1907, by kinds of ore and by States:

Source of gold in 1907 in States and Territories, as reported from the mines to the United States Geological Survey, by kinds of ore and by States, in fine ounces. [a]

State or Territory	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alabama	2.03	1,232.35	22.50					1,256.88
Alaska	797,752.13	133,751.31	4,540.37					936,043.81
Arizona	2,171.60	80,505.12	41,829.37	2,043.55	13.94	48.94		126,612.52
California	330,918.62	461,147.80	16,661.37	459.75			25.98	809,213.52
Colorado	4,877.65	949,448.09	8,827.39	40,725.26	589.35	1,303.81	1,695.59	1,007,467.14
Georgia	1,132.61	1,918.50	83.98					3,135.09
Idaho	17,265.28	34,409.04	5,894.26	3,113.52			72.60	60,754.70
Montana	16,866.77	99,731.08	30,772.08	6,465.48	5,135.10			158,970.51
Nevada	2,673.93	553,431.08	965.56	8,797.18		19,216.45	226.93	585,311.14
New Mexico	935.56	12,034.78	2,326.90	665.64				15,962.88
North Carolina	475.72	3,275.27	225.09					3,976.08
Oregon	16,031.77	37,861.99	734.24					54,628.00
South Carolina	44.75	2,604.51						2,649.26
South Dakota	44.70	200,140.19						200,184.89
Tennessee			185.04					185.04
Texas		.44						.44
Utah	438.35	42,853.89	158,154.83	46,170.73		123.77	18.06	247,759.63
Vermont			1.98					1.98
Virginia	5.66	395.22	.05					400.93
Washington	1,057.47	10,769.20	706.03					12,532.70
Wyoming	195.68	37.25	219.09					452.02
Total	1,192,890.28	2,625,547.11	272,150.13	108,441.11	5,738.39	20,692.97	2,039.16	4,227,499.16

[a] Illinois, Kentucky, Philippines, and Porto Rico not included.

General statement.—The totals in this table indicate that siliceous or dry ores, which in general may be considered as gold ores proper, furnished about 62 per cent of the whole production, and that placers yielded approximately 26 per cent. The base-metal ores contributed between 9 and 10 per cent of the total output, although the tonnage of these ores, as shown in a previous table, was exceedingly heavy. The copper ores yielded most of the gold from this source, while the lead ores only gave a small percentage, and the gold from zinc ores was insignificant in amount.

Compared with 1906, the placer gold decreased by about $2,400,000. The gold from siliceous ores decreased approximately $7,000,000. Copper ores yielded almost exactly the same amount of gold as in 1906. The gold from lead ores and copper-lead ores increased slightly. There was, on the other hand, a considerable decrease in the always small quantity of gold obtained from lead-zinc ores.

Placers.—The placer gold obtained in 1907 aggregated 1,192,890 fine ounces, equivalent to $25,659,225, while in 1906 the quantity was 1,328,361 fine ounces, equivalent to $27,459,653. The great advance in the yield of placer gold which took place in 1905 and 1906 was thus followed by a considerable setback in 1907. Alaska led in the production, with about $16,000,000, and was followed by California, which yielded about $6,840,000. In all the other States the production is very materially smaller. Montana, like Alaska and California, reported a considerably reduced yield, amounting to about $350,000. Idaho remained at about the same figures, and Oregon contributed $331,000, a somewhat decreased output as compared with 1906. Many of the other States showed an increase in their small production. Among these are Arizona, Colorado (in which State the output was almost doubled in 1907), Nevada, Utah, and Washington.

Gold dredging has developed into a most important industry in California. The yield from this branch of mining in that State in recent years has been as follows: 1904, $2,187,038; 1905, $3,276,143; 1906, $5,098,359; 1907, $5,065,437. It is not unlikely that 1908 will show an increase over 1907. Fifty-seven dredges were operating in California. The total yield from all dredging operations, outside of California, was only $571,659, divided between Alaska, Colorado, Georgia, Idaho, New Mexico, Montana, and Oregon. Details can not well be given without disclosing individual production. Seventy-nine dredge boats were in operation as follows: Alaska, 4; California, 57; Colorado, 3; Georgia, 2; Idaho, 6; New Mexico, 1; Montana, 4; and Oregon, 2. No gold was reported from dredging along Snake River.

Drift mining in frozen ground has yielded most of the gold from the Lower Tanana in Alaska, and a large part of the gold from the Seward Peninsula is also obtained by this method of mining. In California drift mining still remains an important branch, but the yield is declining, and was only about $565,575 in 1907.

The remaining placer gold is won by the hydraulic method or by surface sluicing work, which is practiced in all of the placer States. A very small amount of placer gold is derived from dry washing in New Mexico and Arizona.

Dry and siliceous ores.—The States which yielded over 100,000 ounces from this source rank as follows: Colorado, Nevada, California, South Dakota, Alaska, and Montana. Compared with the preceding year decreases are common in the States. The only gains are reported from Arizona, Georgia, Idaho, Nevada, North Carolina, and Washington. The division necessarily includes many varieties of ore, and several different methods of reduction are applied to them. The gold ores of California, Oregon, and Alaska are as a rule free milling, though concentration and cyaniding of tailings are very often combined with the simple amalgamation process. The ores of the Homestake mine in South Dakota fall into the same general class as do the Telluride and Ouray siliceous ores and ores from many scattering occurrences in Idaho, Colorado, and Arizona.

In many cases in Colorado, in Yavapai County, Arizona, and in other places, the siliceous ore contains but little free gold and is concentrated without amalgamation.

The pan-amalgamation process for siliceous gold-silver ores has become almost obsolete, and is used at only a few places in Montana, Nevada, and Arizona. The rich siliceous ores of western Nevada were to a great extent sold to lead or copper smelters, although the high contents in alumina are objectionable in some of them. The rich Goldfield ores were widely distributed among the smelters from California to Denver. The Tonopah ores were also largely shipped to smelters. Freight and treatment charges on this class of ores ranged from $12.50 to $42 per ton, the latter for the richer ores, containing $100 per ton. Beyond a tenor of $100 per ton the charges increase still further.

Interesting developments have taken place in the reduction of ores from western Nevada. A large tonnage which could not be profitably shipped, and much of that which formerly was shipped, are now treated in large mills at Goldfield, Tonopah, and Rhyolite, by several slightly different processes, including the crushing by stamps or rolls, concentration and cyaniding of tailings. Full description of these various methods of treatment are contained in the section of western mine reports under the heading of Nevada.

The quartzose gold ores formed by replacement of limestone are generally cyanided and yield a total of several hundred thousand ounces. The three most prominent localities are the Camp Floyd (Mercur) district in Utah, the Black Hills of South Dakota, and the Moccasin Mountains of Fergus County, Mont.

The dry or siliceous ores further include the quartzose ores of Cripple Creek, Colorado, in which the prominent characteristic is the occurrence of large quantities of gold tellurides. These ores are partly smelted, partly chlorinated, and partly cyanided, all three processes being applicable.

There is, finally, a large class of dry ores which contain pyrite and other sulphides, and which are best treated by the smelting process, with or without concentration. Colorado contributes by far the largest quantity of these ores, among which those of Leadville are of particular importance.

Copper ores.—In 1907, 272,150 ounces of gold were obtained from copper ores, against 271,197 ounces in 1906. The loss is smaller than would have been expected, and this is probably accounted for by the fact that toward the end of 1907 operations were suspended principally in those copper mines which carry only a slight amount of gold. The important States rank as follows: Utah, Arizona, Montana, California, Colorado, and Idaho. It will be observed that the Utah copper ores are by far richer in gold than those of any other State. In spite of its immense tonnage Arizona yielded only about one-fourth of the production of Utah from this source. Most of this came, moreover, from a single camp, the United Verde. The gold from the Butte ores declined very materially. Compared with 1906 a remarkable increase is shown by Utah, due largely to an increased amount of rich ores from Tintic. Idaho, New Mexico, and California added materially to their output from this source. The decreases are in Montana and Arizona.

The copper ores which contain gold are chiefly of sulphide class. Chalcocite is the most abundant mineral, though in some districts chalcopyrite prevails. Oxidized ores are still extensively mined at Bisbee, Ariz., and Tintic, Utah; also at the Snowstorm mine in Idaho, and at some other places. The sulphide ores are ordinarily concentrated and smelted; the oxidized ores are smelted without concentration. The gold is recovered by electrolytic refining of the copper.

Lead ores.—From lead ores and mixed copper and lead ores approximately 129,000 ounces were recovered, which represents a considerable increase over 1906, most of which was due to the mining of rich lead ores at Tintic. Colorado decreased its output very materially, and losses were also shown in Arizona and Idaho. A somewhat increased production is recorded from Montana and Nevada. The States producing gold from lead ores rank as follows: Utah, Colorado, Nevada, Montana, Idaho, and Arizona. The first two States are far ahead of the others. The lead ores are chiefly of the sulphide class. Large quantities of oxidized ores are, however, still furnished by the Tintic district.

Zinc ores and zinc-lead ores.—Only small amounts of gold are recovered from zinc ores. A total of 5,738 ounces was recovered from pure zinc ores; nearly the whole of this was derived from Montana, Colorado contributing only a fraction. The zinc ores of Leadville contain very little gold. The zinc-lead ores yielded only 2,039 ounces, against 11,691 ounces in 1906. This decrease is due to the cessation of mining of zinc ores at Leadville because of the low price of spelter.

DISTRIBUTION OF SILVER PRODUCT IN 1907.

The following table shows the source of silver in the United States in 1907, by kinds of ore and by States:

Source of silver in 1907 in States and Territories, as reported from the mines to the United States Geological Survey, by kinds of ore and by States, in fine ounces.[a]

State or Territory.	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alabama	....	189	250	....	....	....	....	439
Alaska	75,526	22,203	52,055	....	....	....	....	149,784
Arizona	365	976,600	1,416,964	112,923	519	4,526	....	2,511,897
California	37,276	410,903	607,726	66,691	....	600	15,662	1,138,858
Colorado	1,906	7,409,999	143,103	2,357,981	52,173	98,382	1,166,232	11,229,776
Georgia	52	32	780	....	....	....	....	864
Idaho	3,518	843,077	536,007	6,817,839	....	....	214,990	8,415,431

[a] Illinois, Kentucky, Philippines, and Porto Rico not included in this table.

Source of silver in 1907 in States and Territories, as reported from the mines to the United States Geological Survey, by kinds of ore and by States, in fine ounces—Continued.

State or Territory.	Placers.	Dry or siliceous ores.	Copper ore.	Lead ores.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
Michigan			299,764					299,764
Missouri							25,692	25,692
Montana	2,909	1,697,045	7,163,088	328,385		126,178		9,317,605
Nevada	1,846	6,477,524	81,612	282,210	7,668	[a] 204,335	28,408	7,083,603
New Hampshire				174				174
New Mexico	173	542,252	115,323	45,393			2,403	705,544
North Carolina	53	722	20,892					21,667
Oregon	2,791	83,080	847					86,718
South Carolina	4	120						124
South Dakota	6	93,889						93,895
Tennessee			58,358					58,358
Texas		303,688						303,688
Utah	97	131,596	3,448,172	7,300,010	33,059	55,804	21,338	10,990,076
Vermont			3,814					3,814
Virginia		148	73					221
Washington	212	44,972	2,970	7,205				55,359
Wyoming	74	3	3,638					3,715
Total	126,808	19,038,042	13,955,436	17,318,811	93,419	489,825	1,474,725	52,497,066

[a] Includes small amount of copper-zinc ore.

General statement.—The total silver product for 1907 was, as usual, divided chiefly between siliceous ores, copper ores, and lead ores. The proportion is, however, somewhat different from 1906. Only a small quantity is recovered from placers, most of which is credited to Alaska. In percentages of the total the division is as follows: Siliceous ores, 36.4 per cent; copper ores, 26.8 per cent; lead ores, 32.5 per cent; copper-lead ores, 1 per cent; lead-zinc ores, 3 per cent; zinc ores, 0.2 per cent; placers, 0.2 per cent.

Dry and siliceous ores.—The total quantity from this source was 19,038,042 ounces, compared with 16,792,799 ounces in 1906. The important States rank as follows: Colorado, Nevada, Montana, Arizona, Idaho, New Mexico, and California. The larger part of these ores are not silver ores proper, but gold-silver ores. Only about 1,500,000 ounces were recovered from ores carrying exclusively silver values. Silver is practically a by-product of smelting ores and gold-silver milling ores. The production of Colorado was obtained from the gold-silver ores, partly free milling, from the Gilpin and San Juan regions, also from mixed ores, either pyritic or siliceous, which are concentrated and smelted and which also contain copper, lead, or gold. The silver from siliceous ores in Nevada remained at about the same figure as in 1906; most of it is derived from the siliceous gold-silver ores of Tonopah. The production of Montana, which showed a notable decrease, is largely derived from the pure silver ores from Granite County and mixed siliceous ores from other counties. In no other State does the quantity of silver reach 1,000,000 ounces.

The silver is recovered from siliceous ores by amalgamation or cyanide processes; some rich siliceous ores are smelted and the silver obtained by desilverization of lead bullion or by electrolytic refining of copper.

Copper ores.—From copper ores 13,955,436 ounces were recovered; a decrease of somewhat less than 2,000,000 ounces is shown compared with 1906. The States rank as follows: Montana, Utah, Arizona, California, and Idaho; none of the other States produce over 500,000 ounces. A decrease of 2,800,000 ounces was reported from Montana. Utah showed an increase of over 700,000 ounces, due to the mining of an increased tonnage of the rich Tintic ores. The output of Arizona, which was about 300,000 ounces less than that of 1906, is mainly derived from the United Verde copper district.

Lead ores.—The total of silver derived from lead ores was 17,318,811 ounces. Utah was the most important State, with a production of 7,300,010 ounces from Park City, Tintic, and Bingham ores. Idaho was next, with somewhat over 6,800,000 ounces, a decrease of about 800,000 ounces from 1906. Colorado was third in rank, having yielded 2,357,901 ounces from these kinds of ores. No other State even approached Utah, Idaho, and Colorado in this respect. Montana was formerly an important producer, but now yields only a few hundred thousand ounces.

Oxidized lead ores are still furnished by Tintic, Utah; Aspen, Colo., and other places in Colorado, Arizona, New Mexico, and Nevada.

Copper-lead ores.—In the report for 1906 a large output of silver from copper-lead ores was credited to Utah, but it has been found possible in 1907 to distribute most of this output among the lead ores and copper ores. These ores are mined in Tintic, and the same mine often produces both classes of ores. Aside from this district the mixed copper-lead ores are of small importance.

Zinc ores and zinc-lead ores.—The zinc ores proper contribute only a small amount of silver; such ores were shipped from Colorado and Utah. The zinc-lead ores are produced chiefly in Colorado, and in 1907 yielded about 1,500,000 ounces. They are usually concentrated into zinc and lead products. The decrease in the activity of zinc mining found expression in a greatly reduced yield. As usual, Colorado contributed the greatest output, but smaller quantities were also mined in Idaho, Utah, Nevada, California, and New Mexico.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE UNITED STATES.

(MINE PRODUCTION.)

PREFATORY NOTE.

The following account of the production of gold, silver, copper, lead, and zinc by mines in the various States is a part of the annual report on the gold, silver, copper, lead, and zinc industries in the United States. The portion of this general report dealing with mine production has been divided, for the sake of convenience and for distribution in advance of the final volume, into three sections corresponding to broad geographic divisions of the country. As a part of a comprehensive report devoted to the whole country, each section has a certain system and uniformity of treatment imposed upon it which might not in all cases be necessitated by the local conditions of the particular region with which it deals. Accordingly, the general scope of treatment, the arrangement, the tables, and the units of measurement conform as far as possible with those of the sections devoted to other parts of the country as being best adapted to expression of the features of the mining industry of the entire United States. The short ton of 2,000 pounds is used throughout. The price per unit of the production (gold excepted, which is fixed by law) is based upon the average for the year 1907 of daily New York prices for the metals, as follows:

Gold	per fine ounce (troy)	$20.671834625323
Silver	do	.66
Copper	per pound	.20
Lead	do	.053
Zinc	do	.059

It is to be understood, of course, that the full market values are not received for the metals in ore and intermediate products sold to the custom plants.

The full report on the industries of gold, silver, copper, lead, and zinc embraces the following sections:

Production of Gold and Silver.
Production of Copper.
Production of Lead.
Production of Zinc.
Production of Gold, Silver, Copper, Lead, and Zinc in the Western States (Mine production).
Production of Silver, Copper, Lead, and Zinc in the Central States (Mine production).
Production of Gold, Silver, Copper, Lead, and Zinc in the Eastern States (Mine production).

The first four sections give summary reviews of the respective industries, together with general statistics based on returns from mints, refineries, and smelters; the last three sections give reviews of the industries also, by States, counties, and mining districts, and the production of each metal as reported directly to the Survey from the mines.

Each of these sections is published as a separate pamphlet and may be secured by addressing a request to the Director of the United States Geological Survey, Washington, D. C.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE WESTERN STATES.

(MINE PRODUCTION.)

PRODUCTION BY STATES AND TERRITORIES.

ALASKA.

By ALFRED H. BROOKS.[a]

INTRODUCTION.

Though the opening of the year 1907 gave every promise that the notable advance in the metal-mining industry of Alaska begun in 1906 would be continued, yet various factors have led to a very decided decrease in the output of the gold mines. The decrease in gold production, which amounts to about 10 per cent compared with 1906, is due, for the most part, to the labor difficulties that prevailed at Fairbanks during the operating season and also to labor strikes of shorter duration in the Seward Peninsula and at the Treadwell mines. The decrease in copper production was due to the fall in the price of copper and the consequent depression in the copper-mining industry throughout the country. Had the Alaskan copper mines not been remarkably prosperous during the first half of 1907 there would have been a much greater falling off in the copper output. As it is, although the gold mines will probably recover rapidly and show an increase in 1908, provided labor troubles can be avoided, the copper-mining industry of the Territory is less likely to regain its prosperity within another year. There can be no doubt that, had it not been for these adverse conditions, the mineral output of Alaska for 1907 would have exceeded that for 1906, and, considering them, the production was large.

As in previous years, Fairbanks took the lead in gold production, the Seward Peninsula was second, and the lode mines of the Juneau district third. The larger part of the copper production came from the Ketchikan district, but there was a considerable output at Prince William Sound. Aside from actual production, there was a healthy growth in the mining industry throughout the Territory. Much attention was given to the installation of large mining plants in the placer districts, and a large amount of capital was invested for the purpose of constructing a railway to the Controller Bay coal field and the lode deposits of the Copper River region.

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[a] In the preparation of this report valuable aid has been rendered by many members of the Alaskan division. Special mention should be made of C. W. Wright, who compiled the statistics on lode mines, and of E. M. Aten, who collected and compiled the statistics of the gold placers.

The systematic collection of statistics from the producers begun in 1905 was continued during 1907. The first step was to compile as accurate a roster of the mine operators in each district throughout the Territory as circumstances permitted; second, to mail to each operator a schedule with the request to furnish information regarding the production of his mine. It is a matter of gratification that there has been a general tendency throughout the Territory to furnish the desired information. Most of the mining men have been quick to realize the importance of the compilation of accurate statistics, and also that this can only be done by statements of actual production from individual operators. Strangely enough, it is the small operators who have been the quickest to grasp the purposes of these statistics and to accept the guarantee of the members of the United States Geological Survey that the data of production of individual mines will be held confidential. Several of the largest companies and operators who have been particularly benefited by the work of the Survey have yet failed to take a broad public view of this question, although most of those who have refused to furnish the statistical information have shown a great desire to cooperate in all other matters. However, several of the delinquents of last year have this year changed their point of view and have cheerfully furnished the statistical data, and when the others are fully convinced of the purposes and uses to which the figures are put it is thought they will also join the ranks of those who are cooperating in this work.

It should be borne in mind by the mine operators that if these statistics are not collected each year they are lost forever. General estimates, such as those for the placer production given herein, are not without value, yet they can not be relied upon for accurate information, as can the statistics made up by returns from the mine operators themselves. In the past Alaska, as a whole, has suffered from the fact that no accurate statistics of metal production were available. It is known that at least in one case (and there were probably many others) a large amount of gold which should have been credited to Alaska was credited to one of the States. It is also known that in many cases gold which should have been credited to one district has found its way into another district of the Territory and has been reported as part of the output of that district.

As in previous years, the figures contained in the following pages referring to gold placers are based in part on the statements of individual operators, which in turn are supplemented by the best information available. The writer is under special obligations to the many United States commissioners throughout the Territory who have aided in this work, as have also bank officials, the agents of the customs service, and many prominent residents. All this information has been carefully sifted, and the accompanying figures are based upon it. The limit of error of the statement of the total gold production of the Territory is believed to be within 2½ or 3 per cent. In the crediting of the proper amounts to individual districts, however, the error may in some cases be as high as 10 or 15 or even 20 per cent. The foregoing statement applies only to the placer output.

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[a] Bull. U. S. Geol. Surv. No. 345, 1908, pp. 30–36.

The statistical data from the lode mines is practically complete, as all but one operator have furnished statement of production. A preliminary statement of the distribution of the gold output has already been published.[a]

The following table is an estimate of the total gold production of Alaska since the beginning of auriferous mining in 1880. For the early years the figures are probably very far from being correct, but they are all that can be given in the present stage of our information:

Production of gold, silver, and copper in Alaska, 1880–1907.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value, commercial.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
1880	968	$20,000	10,320	$11,146	3,933	$826
1881	1,935	40,000			....	....
1882	7,256	150,000			....	....
1883	14,566	301,000			....	....
1884	9,728	201,000			....	....
1885	14,513	300,000			....	....
1886	21,575	446,000			....	....
1887	32,653	675,000			....	....
1888	41,119	850,000	2,320	2,181	....	....
1889	43,538	900,000	8,000	7,490	....	....
1890	36,862	762,000	7,500	6,071	....	....
1891	43,538	900,000	8,000	7,920	....	....
1892	52,245	1,080,000	8,000	7,000	....	....
1893	50,213	1,038,000	8,400	6,570	....	....
1894	61,927	1,282,000	22,261	14,257	....	....
1895	112,642	2,328,500	67,200	44,222	....	....
1896	138,401	2,861,000	145,300	99,087	....	....
1897	118,011	2,439,500	116,400	70,741	....	....
1898	121,760	2,517,000	92,400	54,575	....	....
1899	270,997	5,602,000	140,100	84,276	....	....
1900	395,030	8,166,000	73,300	45,494	250,000	40,000
1901	335,369	6,932,700	47,900	28,598		
1902	400,709	8,283,400	92,000	48,590	360,000	41,400
1903	420,069	8,683,600	143,600	77,843	1,200,000	156,000
1904	443,115	9,160,000	198,700	114,934	2,043,586	275,676
1905	536,101	15,630,000	132,174	80,165	4,805,236	749,617
1906	1,066,030	22,036,794	203,500	136,345	5,871,811	1,133,260
1907	936,044	19,349,743	149,784	98,857	6,308,786	1,261,757
Total	5,709,914	122,935,237	1,677,159	1,046,362	20,843,352	3,658,538

Gold and silver production for 1880–1904, based on estimates of Director of Mint; for 1905–1907, from figures of United States Geological Survey.

Gold and silver quantities in fine ounces. Silver values are average commercial values for year and not coinage value. Copper production for 1880, from Tenth Census, vol. 15, p. 800; for 1900–1904, copper values are based on average value for year.

Alaska not being divided into counties, the distribution is referred to the geographical provinces in general use, such as southeastern Alaska, Copper River Basin, Cook Inlet region, Yukon Basin, and Seward Peninsula. The production of individual mining districts,[a] when available, has been given.

In the general tables southeastern Alaska, Prince William Sound, and the beach placers along the Pacific seaboard are combined under the name Pacific coast belt.

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[a] The term "mining district" has no legal significance in Alaska. The administrative unit of the Territory is the recording precinct. Unfortunately the boundaries of some of these are changed so frequently that they can not always be used for comparative statistical work.

PRODUCTION.

The figures of the total production of gold, silver, and copper in the years 1906 and 1907 are shown in the following table:

Production of gold, silver, and copper in Alaska, 1906–7.

	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold......fine ounces..	1,066,029.91	$22,036,794	936,043.81	$19,349,743	−129,986.10	−$2,687,051
Silver............do....	166,068	111,266	149,784	98,857	− 16,284	− 12,409
Copper ....pounds..	5,871,811	1,133,260	6,308,786	1,261,757	+436,975	+ 128,497

The gold production of Alaska in 1907 is estimated at $19,349,743 and the silver at $98,857; the number of ounces of gold was 936,043.81 and of silver 149,784. In 1906 the output of gold was valued at $22,036,794. This decrease of $2,687,051 is due largely to the falling off in the output of the Fairbanks district because of labor difficulties. Labor troubles also led to a decrease in the value of the gold production in the lode mines of the Juneau district and of the placer mines of the Seward Peninsula. The copper output of Alaska for 1907 is estimated at 6,308,786 pounds, valued at $1,261,757, an increase in quantity of 436,975 pounds, and in value of $128,497. Considering that many of the Alaskan copper mines were closed down in the summer of 1907 because of the general depression in the copper mining industry, the production can be considered very satisfactory.

Production of gold, silver, and copper in Alaska in 1907, by districts.

District.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Pacific coast belt, including southeastern Alaska and Prince William Sound	139,888.06	$2,891,743	74,415	$49,114	6,308,786	$1,261,757
Copper River and Cook Inlet....	13,303.13	275,000	1,785	1,178		
Yukon Basin........................	444,227.65	9,183,000	48,087	31,738		
Seward Peninsula	338,625.00	7,000,000	25,497	16,828		
Total........................	936,043.81	19,349,743	149,784	98,857	6,308,786	1,261,757

In the following table the gold production of 1906 and 1907 is shown by districts:

Value of gold production in Alaska in 1906 and 1907, by districts.

District.	1906.	1907.	Increase (+) or decrease (−).
Pacific coast belt, including southeastern Alaska and Prince William Sound	$3,454,794	$2,891,743	− $563,051
Copper River and Cook Inlet regions....................	332,000	275,000	− 57,000
Yukon Basin....................	10,750,000	9,183,000	−1,567,000
Seward Peninsula....................	7,500,000	7,000,000	− 500,000
Total	22,036,794	19,349,743	−2,687,051

With regard to the source of the metals according to character of deposits, the gold placers are by far the largest producers, more than four-fifths of the entire output being credited to this source. The siliceous ores are next in value of product, and the copper lode mines last. The gold value of the auriferous lode mine production was $3,348,943 in 1906 and $2,764,885 in 1907, a decrease of $584,058, which is to be charged to labor troubles.

In the following table the source of the precious metals is indicated:

Source of gold, silver, and copper in Alaska in 1907, by kinds of ore.

Ores.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Siliceous ores	133,751.31	$2,764,885	22,203	$14,653	....	....
Copper ores	4,540.37	93,858	52,055	34,357	6,308,786	$1,261,757
Placers	797,752.13	16,491,000	75,526	49,847	....	....
Total	936,043.81	19,349,743	149,784	98,857	6,308,786	1,261,757

Thirteen gold and silver lode mines were on a productive basis in 1907, as compared with 11 in 1906. It is yet impossible to state definitely the number of placer mines in operation. It is believed that, counting operators who work but a single claim, between 1,200 and 1,300 different mines were more or less productive in 1907.

Thirteen copper mines were on a productive basis during 1907, as compared with 14 in 1906.

The tonnage of all the lode mines of Alaska in 1907 was 1,308,566 short tons, a decrease of 201,619 tons from 1906. Of siliceous ores 1,209,639 tons were mined, of which 1,131,486 tons must be credited to the Treadwell group of mines on Douglas Island, near Juneau, leaving only 78,153 tons as the output of the other gold quartz mines. The average gold and silver extraction from all siliceous ores was $2.30 per ton. For the 78,153 tons of the siliceous ores other than those from the Treadwell group, it was $3.41 per ton. The content of silver in siliceous ores is less than 1 per cent of the value of the ore. A total of 98,927 tons of copper ores yielded an average of $1.30 per ton of gold and silver, and copper to amount of 3.18 per cent of the ore.

REVIEW BY DISTRICTS.[a]

PACIFIC COAST BELT.

SOUTHEASTERN ALASKA.

During 1907 the lode-mining industry of southeastern Alaska was less prosperous than in 1906. The decline in the price of copper led to the closing down of a large number of the copper mines in the Ketchikan district. Many of these mines, favorably located for economic development, were working on a small margin of profit, and, with a falling copper market, were not encouraged to continue operations.

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[a] Abstracted from Bulletin No. 345.

In the Juneau district, also, the conditions were adverse. A strike closed up the Treadwell group of mines for nearly a month, and the litigation in the Berners Bay district was not settled as had been anticipated.

Ketchikan district.—As in previous years, there is little to report in regard to the gold mining in Ketchikan district, as the output from auriferous lodes is comparatively insignificant. On Prince of Wales Island work was continued on the Valparaiso property, near Dolomi; and on the Julia claim, near Hollis, an inclined shaft 220 feet deep was sunk on a vein, and from this shaft several drifts were extended. There were also some operations on the Crackerjack mine, near Hollis, in the early part of the year; but in June all work was suspended. There were no other productive mining operations on auriferous lodes in the Ketchikan district, though considerable prospecting was done.

In spite of the fact that a number of the copper mines of the district were in operation for only a part of the year, the copper production was 4,758,814 pounds—an increase of 408,243 pounds over 1906.

On the west side of Prince of Wales Island the Jumbo mine was actively developed throughout the year and made shipments of copper ore to the Tyee smelter in British Columbia. The Red Wing mine was also operated throughout the year, and the Corbin mine for a part of the time. Several copper prospects were also being developed in the same general region, but none of these was productive during 1907. The properties of the Alaska Copper Company, including the smelter located at Copper Harbor, were not operated during the year.

Kasaan Peninsula, on the eastern side of Prince of Wales Island, continues to be the center of the copper mining industry in the Ketchikan district, and hence in southeastern Alaska. Up to September, 1907, the Mamie mine was operated, the ore being utilized by the smelter, near at hand at Hadley, belonging to the Alaskan Smelting and Refining Company; but in September all operations ceased. The adjacent Stevenstown mine was operated until July, when mining was suspended. The Mount Andrew, on the south side of the peninsula, was operated until October, 1907, shipping its ore to British Columbia. The Rush & Brown property, on Karta Bay, was in operation during most of the year 1907. Its ore was shipped to the Tyee smelter at Ladysmith in British Columbia. Some work was also done at the Uncle Sam mine, on the south side of the Kasaan peninsula, as was also at the Eagle's Nest group, where operations extended into September, 1907. The Mammoth group was also operated in the early part of 1907, shipping its ores to the Hadley smelter.

The Niblack mine on the south side of Niblack Anchorage, eastern part of Prince of Wales Island, was operated throughout the year. The shaft has reached a depth of 320 feet, and from this a 300-foot level was driven in 1907.

Juneau district.—Operations were in progress at most of the mines within the Juneau district, though there were few important advances to be chronicled during 1907. There has been considerable prospecting along the gold belt to the north of Eagle River at the head of Gold Creek, but on Douglas Island and south of Juneau no new mines are reported.

At the Alaska Treadwell a shaft has been sunk to a depth of 1,650 feet. The ore extracted during the year was principally from the 750 and 900 foot levels. On adjacent property, the so-called Seven Hundred Foot claim, the 990-foot level was extended to connect with the 1,050-foot level of the Treadwell mine. At the Mexican mine most of the work has been directed toward the opening up of stopes from the 550-foot to the 770-foot level on the hanging wall ore bodies. On the 880-foot and the 990-foot levels stopes have been extended into the main ore bodies. The 1,100-foot level is being extended to the east and west and will undercut the workings on the Seven Hundred Foot claim. The Ready Bullion mine, which extends well out under Gastineau Channel, has attained a depth of 1,650 feet, the principal developments having been extended on the 1,500-foot level. The character of the ore body was not found to change materially at this depth. Most of the ore mined was derived from between the 1,000-foot and the 1,300-foot levels. In the spring of 1907 a strike occurred which tied up the Treadwell properties for several weeks and materially reduced the amount of ore hoisted and milled.

In the Gold Creek region the Ebner, the Alaska-Juneau, and the Perseverance, which have been developing low-grade ore bodies, were operated during 1907. The Ebner mine was operated continuously during the first part of the year with 15 stamps. The Alaska-Juneau mine was operated from June to November, the open-cut mining being impossible during the winter months. At Perseverance underground mine developments were in progress throughout the year. The ore was stoped largely from the main raise, extending from the adit tunnel to the surface, a distance of 920 feet. In November, 1907, 100 stamps were ready for use, but the weather conditions necessitated the discontinuance of milling operations for the year. Improvements are planned by which the stamp mill can be run during the greater portion of the year.

At Silver Bow Basin some placer-mining operations were carried on between May and August. At Peterson Creek, north of Juneau, a 2-stamp mill was used to treat the ore mined during the prospecting. At Eagle River mine developments were actively pushed in search of the main vein, which had been displaced by a fault. The 20-stamp mill on the property was in continuous operation during the year. Considerable prospecting has been done in the region to the north of Eagle River mine, where some promising auriferous veins are being explored.

In the Berners Bay region the Jualin was the only mine in operation during 1907. The developments were principally on the 220-foot level. Other mines in this region have been idle because of litigation difficulties, which still remained unsettled in 1907.

Sitka district.—The only active mining operations during the year in the Sitka mining district have been in the De Groff mine, on Chichagof Island. At this mine a 2-stamp mill has been erected and was operated throughout much of the year. Other prospects in the vicinity are receiving some attention.

COASTAL REGION FROM CROSS SOUND TO ALASKA PENINSULA.

As in previous years, mining continued in a small way on the beach placers at Yaktag, Kodiak, and other localities along the Pacific seaboard. These operations, carried on chiefly with pick, shovel, and rocker, employing 50 to 100 men, yielded a total production which probably does not exceed $25,000 in value.

In the Prince William Sound country there was much prospecting, and several properties made shipments of copper ore. The Bonanza, on Latouche Island, was the largest producer and was operated throughout the year. A crosscut tunnel 900 feet long, cutting the ore body at a level of 90 feet below the old tunnel, was made in 1907. Some work was also done at the Latouche mine, which lies near the Bonanza, and some shipments were made from this property. On the mainland work was continued at the Gladhaugh mine until mid-summer, when operations ceased. A shaft is said to have been sunk to a depth of 670 feet, and the cause of the closing down of the mine is said to be labor difficulties. Several properties were developed in the vicinity of Landlocked Bay, and one of these, the Standard, made some shipments of ore. In all, 5 mines were more or less productive in Prince William Sound region in 1907, and a great many prospects were being opened up. Like the mines in the Ketchikan district, these also felt the depression in the copper-mining industry, and most operations ceased in the latter part of the summer.

COPPER RIVER BASIN.

The only productive mining operations in the Copper River basin were the placer deposits of the Nizina and those of the Chistochina districts, both of which made a small output. In the former no developments of importance have been reported. A complete hydraulic plant was installed on Chititu Creek, a tributary of the Nizina, during the year 1907. There were also a number of small outfits which took out some gold. On Dan Creek, also in the Nizina country, some small operations were carried on and plans were formulated for installing a large hydraulic plant at the mouth of the stream.

In the aggregate there was considerable prospecting along the two copper belts lying respectively north and south of the Wrangell Mountains. The Kotsina-Chitina, or southern belt, is the objective point of two railways now under construction from points near the mouth of the Copper River. Activity in railway construction naturally has stimulated prospecting in this field, but the high cost of labor and all supplies has prevented the systematic development of most of the prospects. In the northern belt, which stretches from the Tanana to White River, the conditions of operating are still worse, and but little has been done in this field except the location of claims.

COOK INLET REGION.

The Sunrise district of Kenai Peninsula, was a small producer in 1907, as were also some streams entering Turnagain Arm to the north. Of more importance in this general field is the development of the Yentna district, which lies about 100 miles from tidewater. The data at hand regarding this district are very inadequate, but a considerable production is said to have been made by small operators. The ground is said to be shallow and of sufficient width to pay for operations on a small scale. Worthy of note also is the reported discovery of placer gold on Valdez Creek, a tributary of the upper Susitna. The field has long been known to be auriferous, but up to 1907 no valuable placers had been found. The data at hand indicate the discovery of coarse gold on a bench deposit.

YUKON BASIN.

The most important features of the mining industry in the Yukon basin during 1907 were the strike of the miners at Fairbanks and the reported discovery of gold on the Innoko, which led many of the strikers to start for the new field. These two factors led to a shortage of labor at Fairbanks during the whole summer and reduced the gold output greatly.

In the Fortymile region there were important developments in the way of installation of dredges. In the Birch Creek region work was done looking to mining operations in a large way, and the same is true of the southern part of the Rampart region.

Fairbanks district.—The falling off of the gold output of Fairbanks district from about $9,000,000 in 1906 to about $8,000,000 in 1907 will, no doubt, be interpreted by those unfamiliar with the conditions as evidence that this district has passed its zenith of production. This is, however, eminently not the case. Had it not been for the labor difficulties, which practically put a stop to the larger mining operations during the months of May, June, and July, and seriously hampered them during the rest of the summer, the output of the Fairbanks district for 1907 would undoubtedly have exceeded that of 1906. The strike was called on April 26, just at the time when the sluicing season began. Most of the operators stood firm, and nearly all the work was suspended. As a consequence, the water available for sluicing at the time of the spring run-off was lost, and many of the winter dumps were not sluiced until late in the fall. Had it not been for the fact that the fall of 1907 was unusually late, there would have been a much larger decrease in the gold production. As a matter of fact, upward of $1,000,000 was taken out after the normal closing season of the Fairbanks districts.

In 1907 Cleary, Fairbanks, Dome, Vault, Esther, and Goldstream creeks and their tributaries were the chief producers of the district. Worthy of special note are the placers developed in 1907 on Vault Creek, which had previously been unproductive. Important developments took place on Esther Creek, which is now second only to Cleary in amount of gold production. Among the important developments of the year was the extension of the Tanana Mines Railway to Cleary Creek. This practically gives railway transportation to all the important creeks of the district.

The discovery of gold in the outlying portions of the auriferous district of Fairbanks indicates a rather larger area carrying productive placers than has been previously supposed. The district is sadly in need of improved methods of mining. At best there is an insufficiency of water supply, and there seems little hope of obtaining it by ditches. It is possible that some of the streams of adjacent regions can be utilized for furnishing electric power and thus reduce the cost of mining.

Of the region tributary to Fairbanks, the Tenderfoot district probably made the largest production, estimated to have a value of $325,000. Some small production was made at the Bonnifield district and investigations were also made looking to the installation of larger plants to exploit large bodies of low-grade gravels. There were no discoveries reported from the Kantishna district, which made only a very small output.

Rampart district.—The total production of the Rampart district in 1907 is estimated at $325,000—a value somewhat greater than that of 1906. The increase is due entirely to the activities on the creeks tributary to Baker Creek in the southern part of the district. Here several ditches were built, and some operations on a larger scale than had been previously known in the district were begun. In the northern part of the field only one hydraulic plant was at work—that on Hunter Creek—though considerable sluicing and some drift mining were done on the other creeks of the district. Worthy of note is the reported discovery of workable placers on Patterson Creek, a tributary of the Tanana. This suggests that the gold-bearing area may have an extension to the southwest.

Circle precinct.[a]—The season was rather dry in the Birch Creek district in 1907, and the gold output was somewhat less than in 1906. Deadwood Creek and Mastodon Creek and tributaries continued to be the chief producers of the district. No new enterprises were inaugurated on the north side of the divide in 1907, though some large properties are said to have changed hands. Some prospecting was done on the lower part of Deadwood Creek looking to the installation of dredges, and the results are said to be favorable. On the south side of the divide considerable developments were made on Eagle Creek, where 2 ditches were constructed, bringing water from both forks to the main creek for hydraulic purposes. Mining continued in a small way on Woodchopper, Fourth of July, and other creeks tributary to the Yukon. The estimated value of the gold production of Circle precinct for 1907 is $200,000.

Fortymile district.—There was a decided decrease in the number of small operators in the Fortymile region and a corresponding falling off in the gold output, which for 1907, including the area tributary to Eagle, is estimated at $150,000. To offset this, however, 4 dredges have been installed in the Fortymile district, and there seems to be every probability that these can be worked profitably, provided the handicap of frozen ground can be overcome. These improved mining methods should give the district a new lease of life, for there is known to be much low-grade ground which can not be profitably developed by pick-and-shovel methods.

Koyukuk district.—The Koyukuk district changed but little from 1906. The gold output is estimated at about $100,000—probably somewhat less than that of 1906. This decreased production is due in large measure to the fact that many men left the Koyukuk because of the new discovery of gold in the adjacent Chandlar district. During the winter of 1907–8 there were rumors of the discovery of very rich placers in the Koyukuk district, but no definite information in regard to this is at hand.

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[a] Often called the Birch Creek district.

Chandlar district.—The Chandlar, a northern tributary of the Yukon, has long been known to carry auriferous gravel, but it was not until 1907 that any systematic attempts at mining were made. The placers occur on Big Creek, a northerly tributary of the Chandlar, and the total production for 1907 is valued at $28,000.

Innoko district.—The Innoko is a large southerly tributary of the lower Yukon. Several years ago there were reported discoveries of auriferous gravel in this field, but up to 1907 nothing very definite was known in regard to it. During the winter of 1906–7 there were reported discoveries of workable placers on Gaines Creek, a tributary of the upper Innoko. These finds caused much excitement in the other Yukon camps, notably Fairbanks, where the news found a large number of dissatisfied miners. As a consequence, some 1,000 or 1,200 men took part in the stampede for the new field. Of these probably several hundred reached the scene of the discovery. Up to the present time it is impossible to make any definite statement in regard to the future of this district. It appears that the gold is rather widely distributed. At least one creek of workable placers has been found. The output from these placers probably did not exceed $10,000.

SEWARD PENINSULA.

The Nome district continues to be the most important producer in the Seward Peninsula, and four-fifths of the gold must be credited to this precinct. Second in importance is the Fairhaven, with the Council, having pretty nearly the same production, as the third. The estimated production for all the districts of Seward Peninsula for 1907 is about $7,000,000, showing a falling off of about $500,000 as compared with 1906. This decrease is chiefly due to labor difficulties, though these were not as serious as at Fairbanks. Another cause of the decrease is that during the last two years much time has been spent in searching for the very rich bonanzas found along the ancient beach line, to the neglect of the development of the lower grade deposits. Since 1905 a large percentage of gold has been taken out of these old beach lines, and very little systematic development work has been done on other forms of deposit. Now that these beach lines are being rapidly exhausted, the gold output of the Peninsula must decrease, unless more systematic operations are undertaken.

Practically all the gold production is from placers, though 1 lode mine is in operation. During 1907 considerable attention was paid to prospecting for lodes. These operations include gold, silver, copper, antimony, and tin deposits.

Nome precinct.—In the Nome precinct operations were chiefly along the third beach line. Some new discoveries were made marking extensions of these beach lines, and also intermediate beaches not previously known were discovered. At Solomon, besides some minor operations, the dredge of the Three Friends Mining Company was continuously operated throughout the season. The Hurrah quartz mine was operated throughout most of the year. During the open season the Topkok Ditch Company operated its hydraulic plant on Daniels Creek, near Bluff.

Council district.—No discoveries of importance were chronicled from the Council district. Nearly all the operations of importance were confined to Ophir Creek. There were some smaller mining enterprises on other creeks.

Kougarok district.—A number of small operators were at work in the Kougarok district in 1907. Two hydraulic plants were, however, also in operation for a part of the summer, and considerable deadwork was done on other properties.

Fairhaven district.—In this district 2 large ditches and 1 small ditch were completed in 1907. Considerable winter mining is done in this field, and there were many small outfits at work in the various creeks.

ARIZONA.

By V. C. Heikes.

PRODUCTION.

The total value of the production of gold, silver, copper, lead, and zinc in Arizona for the year 1907, as reported by 437 producers, including 44 placers, amounted to $55,511,560. Of this total the value of the copper output constitutes 92 per cent, since the Territory produced 254,879,489 pounds of that metal, having a commercial value of $50,975,898. Gold is second in value, the output amounting to $2,617,313, and silver is third, with an output of 2,511,897 fine ounces, which, at the average commercial price for the year, was valued at $1,657,852. This gives a total value for the two metals of $4,275,165, which is $347,370 less in gold value and $369,862 less in silver value, or $717,232 less in value of both metals than for the production of 1906. The greatest output of gold was reported as produced from deep mines and placers in Yavapai County, while Cochise County leads in the production of copper, silver, and lead. No zinc was reported in 1906, but in 1907, the price having reached a high mark, it was profitable to handle ore and concentrates containing that metal, which were shipped to Colorado points from Yavapai, Santa Cruz, and Mohave counties.

At 50 gold and silver mills 202,995 tons of ore, including 16,300 tons of old tailings, were treated, yielding bullion containing $1,275,351 in gold, and 464,963 ounces of silver, valued at $306,875, a total value of $1,582,226, and an average value of $7.79 in gold and silver recovered for each ton of ore treated. The ore treated at 47 concentration mills in 1907, amounting to 1,592,868 tons in quantity, was 15 per cent greater than in 1906. The concentrates, containing gold, silver, copper, lead, and zinc, aggregated 249,036 tons, valued at $11,563,598, or a total average value of $46.43 per ton. Half of the ore mined in Arizona was treated in smelters. It aggregated 1,771,270 tons, valued at $42,320,604 for the gold, silver, copper, lead, and zinc; and it averaged $23.89 in value per ton. Included in the crude ore are 982 tons of tailings and 134,550 tons of old slag which were smelted. Compared with the figures for 1906, the tonnage of ore smelted decreased 144,878 tons in 1907.

The statement of production for 1906 and 1907, showing increase and decrease, and valued at each year's average commercial prices, is as follows:

Production of gold, silver, and associated metals in Arizona in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold ....fine ounces..	143,416.54	$2,964,683	126,612.52	$2,617,313	− 16,804.02	− $347,370
Silver ....do....	3,026,438	2,027,714	2,511,897	1,657,852	− 514,541	− 369,862
Copper ....pounds..	266,831,864	51,498,550	254,879,489	50,975,898	−11,952,375	− 522,652
Lead ....do....	5,638,735	321,408	4,660,684	247,016	− 978,051	− 74,392
Zinc ....do....	....	....	228,490	13,481	+ 228,490	+ 13,481
Total..............	....	56,812,355	....	55,511,560	....	− 1,300,795

Arizona has 11 smelting plants, which were operated in 1907, distributed by counties as follows: In Cochise County, 2; in Gila, 2; in Graham, 3; in Pima, 1; in Santa Cruz, 1; and in Yavapai, 2. All of these smelters treated copper ores. Five of these establishments did a custom business besides treating ores from properties owned by the same interests. About 83 per cent of the smelting ore was treated at smelters connected with mines; the remainder was mainly lead ore and was shipped to outside plants equipped for smelting. The lead-bearing ores were shipped to Needles and San Francisco, Cal.; El Paso, Tex.; and Deming, N. Mex.

The production of ore in Arizona in 1907 was 3,567,133 short tons, including a relatively small quantity of old tailings and slag. Compared with 1906, the production decreased 17,956 tons in quantity, and in value per ton from $15.83 in 1906 to $15.55 per ton in 1907. Production of siliceous ore increased from 272,611 tons in 1906 to 357,005 tons in 1907, an increase of 84,394 tons. The greatest quantity of this kind of ore was produced in Cochise County. Copper ore increased from 3,089,856 tons in 1906 to 3,191,125 tons in 1907, an increase of 101,269 tons. Graham County had the greatest output of copper ore, Cochise County following. The production of lead ore decreased from 221,376 tons in 1906 to 17,364 tons in 1907, or a decrease of 204,012 tons. The average value per ton of gold and silver in siliceous ore in 1907 was $6.47, as against $6.33 in 1906; in copper ore, 56 cents, as against 79 cents in 1906; in lead ore, $6.73, as against $3.49 in 1906; and in copper-lead ore, $15.20, as against $7.96 in 1906.

GOLD.

The gold output of Arizona for 1907, as reported by the producers, aggregated 126,612.52 fine ounces, valued at $2,617,313. Compared with the figures of 1906 this indicates a decrease of 16,804.02 ounces in quantity and of $347,370 in value. The principal gold-producing mines are located in Yavapai, Mohave, Cochise, and Yuma counties. Decreases are to be noted in all of these counties, except Yuma. Forty-nine per cent of the gold produced in Arizona was extracted from ore treated at gold and silver mills, aggregating 202,995 tons, yielding 61,695.09 ounces of gold, and averaging per ton 0.304 ounces, valued at $6.29. From 1,592,868 tons of ore treated at concentration mills, 249,036 tons of concentrates were saved, containing 17,234.62 ounces of gold, valued at $356,271, or an average value per ton of $1.43. There were smelted 1,771,270 tons of crude ore, containing 45,511.22 ounces of gold, valued at $940,800, or an average value of 53 cents per ton. The gold yield from placer mining in 1907 amounted to $44,891, an increase of $4,389 over that reported in 1906. Yavapai, Yuma, and Pima counties produced the largest quantities of placer gold. One dredge of a daily capacity of 300 yards is being installed on Lynx Creek in Yavapai County. Other dredges are contemplated in the same region, and on the Agua Fria River in Maricopa County.

The largest gold producers, named in order of importance, are the Gold Road Mine in Mohave County, the King of Arizona in Yuma County and in Yavapai County, the Gladstone Mine at McCabe, the United Verde at Jerome, and the Congress mines, at Congress.

Source of gold production in Arizona by kinds of ore in 1907, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead-zinc ore.	Copper-lead ore.	Total.
Cochise	40.44	9,199.06	11,581.72	248.71			0.28	21,070.21
Coconino and Maricopa	62.36	509.00	19.78					591.14
Gila	6.10	277.90	2,691.62	25.52				3,001.14
Graham	19.98	228.71	1,225.27	2.11				1,476.07
Mohave		27,234.70	99.07	970.19	13.94			28,317.90
Pima	425.70	199.77	15.96	1.93			5.21	648.57
Pinal	21.43	1,125.37	265.51					1,412.31
Santa Cruz		74.29	11.40	52.03				137.72
Yavapai	1,014.95	28,086.80	25,511.31	732.88				55,345.94
Yuma	580.64	13,569.52	407.73	10.18			43.45	14,611.52
Total	2,171.60	80,505.12	41,829.37	2,043.55	13.94		48.94	126,612.52

Comparison of these totals for 1907 with the gold output for 1906 is as follows:

Production of gold in Arizona in 1906 and 1907, by kinds of ore, in fine ounces.

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead-zinc ore.	Copper-lead ore.	Total.
1906	1,959.29	64,953.71	62,298.80	14,088.98			115.77	143,416.55
1907	2,171.60	80,505.12	41,829.37	2,043.55	13.94		48.94	126,612.52
Increase (+) or decrease (−)	+212.31	+15,551.41	−20,469.43	−12,045.43	+13.94		−66.83	−16,804.03

SILVER.

The yield of silver amounted to 2,511,897 ounces in quantity, valued at $1,657,852. Compared with the figures of 1906, this indicates a decrease of 514,541 ounces in quantity and of $369,862 in value. The output of silver came mainly from copper ores, from which source were derived 1,416,964 ounces, of which 44.2 per cent is almost equally divided between Cochise and Yavapai counties, each county showing a decrease in silver recovered from its copper ores as against the recovery reported in 1906. Siliceous ores produced 976,600 ounces, or 38.8 per cent of the total. This output is 404,979 ounces in excess of the production of 1906. Silver decreased in production in 1907 from copper ore, lead ore, and copper-lead ore. The largest producers of silver, named in order of output, are the Tombstone mine in Cochise County, the United Verde in Yavapai County, and the Copper Queen and Commonwealth mines in Cochise County. The crude ore treated at smelters, 1,771,270 tons in quantity, yielded 1,745,983 ounces of silver, averaging 0.99 ounce per ton. At concentration mills 249,036 tons of concentrates were made, yielding 300,586 ounces of silver, or an average of 1.2 ounces per ton. Gold and silver mills treated 202,995 tons of ore, yielding 464,963 ounces, contained in bullion from amalgamation and cyanide operations, and averaged 2.29 ounces per ton. Cochise, the leading county in silver, is credited with 1,411,301 ounces, valued at $931,459, in 1907, as against 1,757,369 ounces, valued at $1,177,437, in 1906, a decrease of 346,068 ounces in quantity and of $245,978 in value. This is the largest decrease in silver recorded in Arizona.

Source of silver production in Arizona, by kinds of ore, in 1907, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead-zinc ore.	Copper-lead ore.	Total.
Cochise	11	791,464	592,535	26,800			491	1,411,301
Coconino and Maricopa	11	5	2,595					2,611
Gila	1	79	92,319	1,663				94,062
Graham	3	22,596	64,859	120				87,578
Mohave		31,962	19,236	29,180	519			80,897
Pima	64	5,043	76,866	21,818			1,943	105,734
Pinal	5	1,005	19,977	49				21,036
Santa Cruz		2,021	26,626	19,203		1,728	96	49,674
Yavapai	164	117,316	520,049	9,959				647,488
Yuma	106	5,109	1,902	4,131			268	11,516
Total	365	976,600	1,416,964	112,923	519	1,728	2,798	2,511,897

Comparison of these totals for 1907 with the silver output for 1906 is as follows:

Production of silver in Arizona in 1906 and 1907, by kinds of ore, in fine ounces.

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead-zinc ore.	Copper-lead ore.	Total.
1906	274	571,621	1,724,501	718,816			11,226	3,026,438
1907	365	976,600	1,416,964	112,923	519	1,728	2,798	2,511,897
Increase (+) or decrease (−)	+91	+404,979	−307,537	−605,893	+519	+1,728	−8,428	−514,541

COPPER.

In 1907 the output of copper in Arizona amounted to 254,879,489 pounds, valued at $50,975,898. Compared with the figures of 1906 this shows a decrease of 11,952,375 pounds in quantity and of $522,652 in value. The decreases are recorded in Cochise and Yavapai counties, where the greatest curtailments were made at the time of the panic of 1907, but this did not affect any of the other counties in the Territory, as each shows an increase over the production in 1906. The closing of several copper furnaces at Douglas, in Cochise County, and of the entire smelting plant of the Arizona Smelting Company in September at Humboldt, in Yavapai County, is responsible for a large share of the decrease. In Graham County, and probably in others, the large mining companies were known to take advantage of the high price of copper to mine ores containing a low percentage of the metal. Graham County holds second place in the Territory as a producer of copper, Gila third, and Yavapai, which was third in 1906, dropped to fourth place in 1907. Cochise County, however, is credited with 43.1 per cent of Arizona's output, or 110,024,926 pounds, valued at $22,004,985 in 1907. Compared with the figures of 1906 this shows a decrease in 1907 of 20,004,090 pounds in quantity and of $3,090,615 in value, and forms the largest part of the copper decrease in Arizona. The crude ore treated at smelters, or 1,771,270 tons (which includes lead ore), contained 200,274,163 pounds of copper, or an average of 113 pounds per ton, equivalent to 5.65 per cent. Included in this ore to smelters was 134,550 tons of old slag resmelted. The total quantity of concentrates produced in Arizona was 249,036 tons, of which 243,941 tons, or 97.9 per cent, contained 54,604,205 pounds of copper, an average of 223.8 pounds per ton, or 11.19 per cent of copper. The concentrates were produced in the following counties, named according to importance of output: Graham, Gila, Yavapai, Pinal, Santa Cruz, and Cochise, and represented 1,465,048 tons of crude ore mined and concentrated, but they did not include ore treated at gold and silver mills, which produced some concentrates containing copper.

LEAD.

The output of lead decreased from 5,638,735 pounds, valued at $321,408, in 1906, to 4,660,684 pounds, valued at $247,016, in 1907. Larger returns than in 1906 were reported from Mohave and Pima counties. Cochise County, still holding first place with 1,654,773 pounds, was followed by Mohave County with 1,229,654 pounds, which was second in rank for 1907 instead of Santa Cruz County. The latter county took third place in total output, the county output having decreased from 1,468,556 pounds in 1906 to 625,861 pounds in 1907. Crude ore to smelters contained 69.1 per cent of the total output, or 3,222,896 pounds. Concentrates, containing lead produced at concentration mills, aggregated 4,327 tons, and contained 1,399,275 pounds of lead, averaging 323.3 pounds, or 16.16 per cent of lead per ton of concentrates. The concentrates were produced in the following counties, named in order of importance in the ouput of lead: Santa Cruz, Cochise, Yavapai, Mohave, and Pinal. They represent 93,638 tons of crude ore mined and concentrated, which quantity does not include some ore treated at gold and silver mills containing lead, which was saved in concentrates.

ZINC.

The zinc output reported for Arizona in 1907 was estimated as spelter and aggregated 228,490 pounds, valued at $13,481. This was derived from Yavapai, Santa Cruz, and Mohave counties, named according to importance of production, each recording the product of one property. Crude zinc ore was shipped from Mohave County only, the remainder of the production being shipped as concentrates. The total yield of zinc was contained in 392 tons of ore and concentrates, averaging 582.8 pounds per ton. The production and shipment of zinc ore and concentrates from the Territory depend on the grade of product and the price offered. Mohave County will remain a producer of zinc ore during 1908, and possibly Yavapai County will again record the production during that year.

MINING INDUSTRY IN ARIZONA IN 1907.

Throughout Arizona considerable work was reported by mining companies in 1907, not only in the development of mines but also in maintaining an increased production, even during a period when there was a shortage of cars and a scarcity of labor and fuel. In August the decline in the prices of metals commenced to affect the prosperity of the Territory, and it continued to do so through the close of 1907. Arizona surpassed the output of copper of Montana in 1907 and now stands first in the rank of copper-producing States. The price paid to certain copper producers in Arizona declined from 25.52 cents per pound to 12.48 cents per pound for copper delivered in November.[a] Nearly all the smaller producers ceased operations and several large companies curtailed output to a small extent, but nevertheless an increase of production over that of 1906 was shown in each county, except Cochise and Yavapai counties. The profitable extraction of ores containing low percentage of copper often depends upon the quantity of gold and silver contained, and the process of electrolytic copper refining permits these metals to be cheaply separated from the impurities. Certain copper ores at Globe and Clifton, if treated alone, would, on account of the low content in gold and silver, necessarily have their copper turned into casting and not into electrolytic copper, and the precious metals would not be recovered.

Two new milling plants in the San Francisco district, Mohave County, to be equipped for cyanide treatment, were under construction, and the equipment of another for the North Star mines was delivered at Kofa, in Yuma County. One concentration plant in Pima County, in the Silver Bell district, was commenced. These milling plants should be in operation early in 1908.

The copper smelter of the Southern Arizona Smelting Company at Sasco, in Pima County, was almost completed and was to be in operation in January, 1908, to treat the ores of the Imperial mine and possibly certain ore produced at Tombstone, in Cochise County, and concentrate from Poland and Congress in Yavapai County, where mines are located belonging to the same interests. The smelter reported as likely to be built in 1907 near Phoenix did not materialize, and nothing was accomplished in the building of additional smelters at Globe. A lead and copper plant is planned for construction near Tucson by the Arizona Smelting Company. This company has no relation to the company of the same name at Humboldt, in Yavapai County.

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[a] Annual report of Calumet and Arizona Company, 1907, Bisbee, Ariz.

Railroad construction of the Arizona and California line has been completed from Wickenbarg to Parker, on the Colorado River, and is expected to be continued to a connection with the main line of the Santa Fe route in California. The Southern Pacific took under control, in May, the Santa Fe branch line that was being built up the Gila River canyon, and that is to be completed to a connection with the main line. Copper-ore producers in Pinal County, into which the railroad is being built, were greatly affected by the change, as the low freight rates to Humboldt immediately ceased and all ores of profitable shipping grade were diverted to the Deming and El Paso smelters in New Mexico and Texas.

Arizona has 13 counties, from 11 of which mine operators reported production of metals in 1907. Ninety-five mining districts have a production credited to them for 1907. Later in this report a brief review is given of each of the productive counties and districts.

Production of gold, silver, copper, and lead in Arizona in 1907, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Cochise	21,070.21	$135,560	1,411,301	$931,459	110,024,926	$22,004,985
Coconino and Maricopa	591.14	12,220	2,611	1,723	448,492	89,699
Gila	3,001.14	62,039	94,062	62,081	36,875,993	7,375,199
Graham	1,476.07	30,513	87,578	57,801	62,720,962	12,544,192
Mohave	28,317.90	585,383	80,897	53,392	601,210	120,242
Pima	648.57	13,407	105,734	69,784	6,685,700	1,337,140
Pinal	1,412.31	29,195	21,036	13,884	1,191,322	238,264
Santa Cruz	137.72	2,847	49,674	32,785	504,254	100,851
Yavapai	55,345.94	1,144,102	647,488	427,342	35,734,416	7,146,883
Yuma	14,611.52	302,047	11,516	7,601	92,214	18,443
Total	126,612.52	2,617,313	2,511,897	1,657,852	254,879,489	50,975,898

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Cochise	1,654,773	$87,703	....	....	$23,459,707
Coconino and Maricopa	....	....	....	....	103,642
Gila	161,523	8,561	....	....	7,507,880
Graham	14,142	750	....	....	12,633,256
Mohave	1,229,654	65,171	30,666	$1,809	825,997
Pima	300,430	15,923	....	....	1,436,254
Pinal	2,624	139	....	....	281,482
Santa Cruz	625,861	33,171	57,038	3,365	173,019
Yavapai	521,307	27,629	140,786	8,307	8,754,263
Yuma	150,370	7,969	....	....	336,060
Total	4,660,684	247,016	228,490	13,481	55,511,560

The following table shows, by counties, the tons of ore sold or treated, the number of deep mines selling or treating ore, the average total value per ton, and the average value per ton in gold and silver:

Tons of ore sold or treated, number of deep mines producing, and value of ores in 1906 and 1907, by counties.

County.	Ore sold or treated (short tons).		Number of deepminesproducing.		Average total value per ton.[a]		Average value per ton in goldandsilver.[a]	
	1907.	Increase(+) or decrease (−) compared with 1906.	1906.	1907.	1906.	1907.	1906.	1907.
Cochise	1,080,986	−114,662	19	47	$22.59	$21.70	$1.50	$1.26
Coconino and Maricopa	8,728	+ 6,798	3	15	32.13	11.72	8.20	1.45
Gila	444,860	+ 29,389	14	41	13.55	16.88	.31	.28
Graham	1,418,499	+159,338	18	34	9.21	8.91	.11	.06
Mohave	68,887	+ 4,055	27	49	13.12	11.99	11.38	9.27
Pima	57,539	− 7,344	12	42	19.70	24.81	1.12	1.29
Pinal	19,911	+ 17,359	9	30	16.66	14.11	5.86	2.14
Santa Cruz	15,145	−106,904	5	21	1.05	11.42	.35	2.35
Yavapai	375,398	− 21,390	39	91	24.89	23.26	4.32	4.13
Yuma	77,180	+ 15,405	6	23	4.84	4.20	4.65	3.86
Total	3,567,133	− 17,956	152	393	15.83	15.55	1.38	1.19

[a] Value per ton, placer product excluded.

The total tonnage, by kinds of ore sold or treated, in each county of Arizona during 1907, is shown in the following table:

Subdivision of tonnage of ore sold or treated in Arizona in 1907, by counties, in short tons.

County.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead-zinc ore.	Copper-lead ore.	Total.
Cochise	125,336	955,155	401	....	....	94	1,080,986
Coconino and Maricopa	1,700	7,028	....	....	....	....	8,728
Gila	414	444,243	203	....	....	....	444,860
Graham	1,760	1,416,718	21	....	....	....	1,418,499
Mohave	63,846	1,906	3,104	31	....	....	68,887
Pima	390	56,614	464	....	....	71	57,539
Pinal	5,679	14,230	2	....	....	....	19,911
Santa Cruz	123	3,156	10,445	....	1,420	1	15,145
Yavapai	81,464	291,680	2,254	....	....	....	375,398
Yuma	76,293	395	470	....	....	22	77,180
Total	357,005	3,191,125	17,364	31	1,420	188	3,567,133
Value per ton in gold and silver	$6.47	$0.56	$6.73	$20.32	$0.80	$15.20	$1.19

In 1906 the subdivision of the tonnage and the average value per ton in gold and silver were as follows: Of siliceous ore, 272,611 tons, $6.33 per ton; of copper ore, 3,089,856 tons, 79 cents per ton; of lead ore, 221,376 tons, $3.49 per ton; of copper-lead ore, 1,246 tons, $7.96 per ton; total, 3,585,089 tons.

Tonnage of milling and smelting ore and concentrates, and quantity of gold and silver contained in bullion, produced in Arizona in 1907, by counties.

County.	Ore to gold and silver mills.			Ore to concentrating mills.
	Quantity.	Gold in bullion.	Silver in bullion.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
Cochise	[a] 51,411	6,053.13	428,786	62,706
Coconino and Maricopa	1,700	509.04	5	....
Gila	405	101.59	19	138,955
Graham	80	39.50	3	1,264,113
Mohave	[b] 54,605	25,212.98	14,230	9,572
Pima	350	120.93	71	....
Pinal	5,659	1,125.06	355	8,541
Santa Cruz	92	75.10	249	10.775
Yavapai	12,422	14,995.66	16,161	97,786
Yuma	76,271	13,462.10	5,084	420
Total	202,995	61,695.09	464,963	1,592,868

County.	Concentrates produced.						Total value of concentrates.
	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Cochise	1,017	2,409.97	172,353	506	415,138	....	$185,675
Gila	40,093	660.16	16,409	6,152,715	....	....	1,255,020
Graham	193,068	361.79	14,357	47,173,677	....	....	9,451,690
Mohave	944	1,544.03	14,355	1,102	106,835	....	47,275
Pima	35	41.86	2,348	316	8,850	....	2,947
Pinal	481	.27	650	231,599	360	....	46,774
Santa Cruz	1,284	31.80	11,392	8,996	428,400	(*c*)	36,045
Yavapai	12,030	12,184.74	66,172	1,036,415	376,805	(*c*)	531,115
Yuma	84	....	2,550	....	101,400	....	7,057
Total	249,036	17,234.62	300,586	54,605,326	1,437,788	197,824	11,563,598

County.	Crude ore to smelter.						Total value.
	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Cochise	[d] 966,869	12,566.70	810,151	110,024,420	1,239,635	....	$22,865,059
Coconino and Maricopa	7,028	19.78	2,595	448,492	....	....	91,821
Gila	[e] 305,500	2,233.33	77,633	30,723,278	161,523	....	6,250,622
Graham	[f] 154,306	1,054.76	73,215	15,547,285	14,142	....	3,180,333
Mohave	4,710	1,560.91	52,312	600,108	1,122,819	30,666	248,132
Pima	57,189	60.08	103,251	6,685,384	291,580	....	1,421,919
Pinal	5,711	265.51	20,026	959,723	2,264	....	210,769
Santa Cruz	4,278	30.81	38,033	495,258	197,461	....	135,257
Yavapai	[g] 265,190	27,150.56	564,991	34,698,001	144,502	....	7,881,404
Yuma	489	568.78	3,776	92,214	48,970	....	35,288
Total	1,771,270	45,511.22	1,745,983	200,274,163	3,222,896	30,666	42,320,604

[a] Includes 13,800 tons old tailings to gold and silver mills.
[b] Includes 2,500 tons of old tailings.
[c] Production reported from one property in each county.
[d] Includes 63,072 tons of old slag and flue dust.
[e] Includes 34,865 tons of old slag and flue dust.
[f] Includes 36,613 tons of old slag.
[g] Includes 982 tons of tailings for converter lining.

The table following gives the number of mines classified according to their chief products in 1907:

Number of mines in Arizona, classified by chief products in 1907.

County.	Mines reporting product.	Gold placer mines.	Deep mines.						
			Gold.	Silver.	Gold and silver.	Gold, silver, and copper.	Gold, silver, copper, lead.	Gold, silver, and lead.	Gold, silver, copper, lead, and zinc.
Cochise	49	2	....	2	3	25	14	3	....
Coconino and Maricopa	18	3	....	....	1	14	....	....	....
Gila	42	1	....	....	3	34	1	3	....
Graham	35	1	1	1	5	25	1	1	....
Mohave	49	....	....	1	12	14	3	18	1
Pima	44	2	....	....	3	27	9	3	....
Pinal	32	2	....	....	3	23	3	1	....
Santa Cruz	21	....	....	....	3	6	7	4	1
Yavapai	117	26	2	1	21	60	2	4	1
Yuma	30	7	....	....	5	10	3	5	....
Total	437	44	3	5	59	238	43	42	3

PRODUCTION BY INDIVIDUAL COUNTIES.

COCHISE COUNTY.

Production of gold, silver, and associated metals in Cochise County, Ariz., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold......fine ounces..	29,908.81	$618,270	21,070.21	$435,560	− 8,838.60	− $182,710
Silver............do....	1,757,369	1,177,437	1,411,301	931,459	− 346,068	− 245,978
Copper.......pounds..	130,029,016	25,095,600	110,024,926	22,004,985	−20,004,090	−3,090,615
Lead............do....	2,124,605	121,102	1,654,773	87,703	− 469,832	− 33,399
Total	....	27,012,409	....	23,459,707	....	−3,552,702

Source of gold and silver in Cochise County, Ariz., in 1906 and 1907, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Total.
Gold	1906	93.36	5,302.51	17,257.11	7,205.84	50.00	29,908.82
	1907	40.44	9,199.06	11,581.72	248.71	.28	21,070.21
Silver	1906	.13	444,049.00	706,484.00	606,626.00	197.00	1,757,369.00
	1907	.11	791,464.00	592,535.00	26,800.00	491.00	1,411,301.00

In the production of copper, lead, and silver Cochise County leads all others in the Territory, as well as in the total value of its mineral output, which aggregated $23,459,707 in 1907. The ores produced by 47 deep mines in 1907 amounted to 1,080,986 tons, as against 1,195,648 tons from 19 deep mines in 1906—an increase of 28 mines and a decrease of 114,662 tons in 1907. The total average value per ton decreased from $22.59 in 1906 to $21.70 in 1907. Ores treated at smelting plants, including 63,072 tons of old slag and flue dust resmelted, aggregated 966,869 tons, and they contained 12,566.70 ounces in gold, 810,151 ounces in silver, 110,024,420 pounds of copper, and 1,239,635 pounds of lead, which yielded a total value of $22,865,059, or an average value of $23.64 per ton. Crude ore, aggregating 62,706 tons, went to 5 mills equipped with concentrators, and yielded 1,017 tons of concentrates, containing 2,409.97 ounces of gold, 172,353 ounces of silver, 506 pounds of copper, and 415,138 pounds of lead. These concentrates were valued at $185,675, or an average value of $182.57 per ton. At 1 mill equipped with concentrators for the concentration and extraction of the base minerals, further treatment was given the tailing with the cyanide process for the recovery of the included gold and silver. At 4 gold and silver mills, using amalgamation and cyanide processes, 51,411 tons of ore, including 13,800 tons of tailings, were treated, and produced bullion containing 6,053.13 ounces of gold, valued at $125,129, and 428,786 ounces of silver, valued at $282,999, a total value of $408,128, or an average value per ton of $2.43 in gold and of 8.3 ounces in silver.

At Douglas the smelters found difficulty in operating, owing to the railroad congestion, which made it impossible for them to secure oil from California points, the natural source of the supply, and compelled the companies to ship the oil from eastern Texas at much higher prices. It was also necessary to secure a greater part of the coke supply from the East, which also cost more that the western coke. The smelters reduced their output of copper 50 per cent during the latter part of the year.

California district.—On the property of the Savage Gold and Copper Company there was installed a matte furnace to treat 50 tons of ore per day, but it was not in operation during the year. There are 5 shafts at this mine, the deepest of which is 93 feet, and an adit 320 feet long. The Treasury group, owned by the Cochise Consolidated Copper Company, on which property there were installed during the latter part of 1906 Sutton dry concentrators, did not operate during 1907 on account of litigation. The Chamberlain and Morrow property made one small shipment during the year.

Cochise district.—The Peoples Party group, operated by the Magazine Copper Company, made several shipments of copper ore containing silver and some lead. The Republican and Mammoth mines, operated by the Arizona Consolidated Mining Company, are developed by two incline shafts, 500 and 276 feet deep. The ore shipped contained 245,040 pounds of copper and 3,122 ounces of silver, aggregating in value $51,058.[a] The Old Terrible mine was operated during the first part of the year by the Manzora Mining Company, and concentrates and crude ore were shipped to the smelter. The property is equipped with a 20-stamp mill and 3 Wilfley tables. The Mayflower mine made several shipments of crude ore, which contained copper and a small quantity of silver. At the Peabody mine, owned by the Bonanza Belt Copper Company, there was carried on development from the 300-foot incline shaft. Approximately 600 feet of development work was accomplished during 1907. The ore was shipped to El Paso, Tex., and Douglas, Ariz., and aggregated in value $48,832 for the content, consisting of 220,840 pounds of copper and 7,126 ounces of silver.[a]

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Dos Cabezas district.—The property formerly operated by the Cottonwod Mining Company is reported as abandoned. However, the milling plant of the company was leased during the year to work experimentally on various ores of the district. The operators of the Lula property in Apache Pass, owned by the Arizona Gold Mining Company, used the Cottonwood mill in testing their ores. Concentrates produced contained lead, gold, and silver, and some bullion caught on the plates was sold. The Oneida, the Climax, and the Standard claims produced small quantities of crude ore and lead concentrates containing gold and silver. The Sunset Mining and Milling Company produced a car of ore, containing copper and silver.

Hartford district.—There was considerable activity in the Huachuca Mountains. Much development work was done by the Butte and Arizona Copper Company in opening up its property. The adit has been driven a distance of 2,000 feet, and about 100 feet farther it is expected to cut a contact which contained copper ore at the surface, 1,100 feet above the face of the adit. Test shipments were made of the ore. The Mitchell Development Company has done much exploitation work, and the Exposed Reef and other claims taken over by the Sitric Mines Company have had important work performed upon them during the year. The ore from the Reef group was tested thoroughly for the best process of treatment, and it has been decided to make alterations on the old 100-ton cyaniding plant and to equip it with tube mills for grinding the ore. Water is obtained from Carr Peak, 2 miles distant and 100 feet above the camp. This may be used in furnishing power for mining purposes.

Tombstone district.—The Tombstone Consolidated Mines Company produced during 1907 lead ore containing silver and gold aggregating in value $507,009.[a] The Contention, Grand Central, Emerald, Tough Nut, Silver Thread, Tranquillity, West Side, Lucky Cuss, and other claims are operated by this company. The development work is carried on by several shafts, the deepest of which is 1,000 feet, sunk on the Contention claim, through which by the installation of large pumps the unwatering is done. One mile distant from the Contention, in a southeasterly direction, is the Emerald, which has attained a depth of 900 feet since the pumps were put into operation. It is said to be one of the best producing claims in the group. The pumping record continued in the neighborhood of 4,000,000 gallons of water daily; a gradual, but effectual, lowering of the water level throughout the district was recorded and the drainage problem is solved. It is stated that a new ore body, 50 feet below water level, was penetrated the latter part of the year in the Emerald mine. The concentration mill and cyanide plant for treating mill tailings operated the greater part of the year. At the Luck Sure and Black Eagle mines, operated by the Old Glory Mining Company, development work was done and some ore was shipped. The Hershell mine was operated and produced a lead ore containing silver. The property is developed to a depth of 350 feet. A number of prospects in the district have been developed and from them were shipped small lots of ore to the smelter.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Turquoise district.—The Commonwealth Mining and Milling Company has its vertical shaft now at a depth of 540 feet. The milling plant, equipped with 80 stamps and pan amalgamators, operated on ore from the mine and part of the old dump of tailing was re-treated. Bullion was shipped containing 2,734.12 ounces of gold and 314,898 ounces of silver, aggregating in value $262,227.[a] The Copper Belle mine was leased to the Shannon Copper Company at Clifton, Ariz., during 1907, and a large tonnage of copper ore, valuable as a flux, was shipped to the Shannon smelter. This contained 64,982 pounds of copper, 20,843 ounces of silver, and 307.03 ounces of gold, aggregating in value $32,962.[a] The vertical shaft on the property is 350 feet deep, with lateral drifts and crosscuts. The Dragoon Copper Mining and Smelting Company shipped some copper ore to the smelter. The Fluorine Mining and Milling Company has a vertical shaft 100 feet deep. The ore shipped is valuable to the smelters for furnace lining. A cyanide plant is being considered by the company to treat the ore on the property. The Tom Scott mine was operated during 1907 by the Tejon Mining Company, and crude ore was shipped to the smelters, which contained copper, lead, gold, and silver. This property is developed by an adit 747 feet long. The incline shaft on the property is 116 feet deep. The total development work during the year aggregated 1,000 feet. The Gleeson mine was a shipper of a good grade of copper ore containing silver.

Warren district.—The Calumet and Arizona Mining Company and the Superior and Pittsburg Copper Company, both operated under the same management, made regular shipments of copper ore to the smelting plant of the Calumet and Arizona Company at Douglas. The development on the Irish Mag and Oliver claims of the Calumet and Arizona Company aggregated 23,016 feet during 1907. At the Irish Mag the most important discoveries have been made in the blocks of ground southeast of the shaft, where high-grade oxide ore has been reported on both the 950 and 1,050 levels. The development of these ore bodies is reported to assure the existence of stoping ground all the way between the 850-foot and 1,050-foot levels. To learn whether the ore extended upward to the 650-foot level, a drift was driven on that level almost continuously in leached and copper-stained material with occasional streaks of ore, but no ore of value is reported. In the Oliver shaft the ore bodies on the 1,050-foot level have been explored much beyond what had previously been considered as their limits. The most important discovery of the year has been in finding sulphide ore on the 1,150-foot and the 1,250-foot levels. The work at these levels yields copper ore, which is principally made up of the minerals chalcopyrite and bornite. There were produced and smelted from the Calumet and Arizona property 232,460 tons of crude ore, averaging 6.56 per cent copper recovered. The total of refined copper produced at the smelter amounted to 30,688,289 pounds, which yielded a value in gold and silver of $210,846, an average of $13.74 per ton of refined copper. The Calumet and Arizona smelter at Douglas made extensive changes in the enlargement of its plant. A machine shop was erected and the converter building extended. It is expected to increase the capacity by 500 tons by the erection of a sixth furnace and by enlarging the old furnaces by making them each 10 feet longer, thus changing their capacity from 300 to 500 tons each. This will make the total capacity 3,000 tons of ore per day instead of 1,500 tons as at present. The Superior and Pittsburg Company carried on development work at the Cole, Briggs, Junction, and Hoatson mines, in which the total development amounted to 23,332.5 feet. The Cole shaft was sunk 91 feet during the year, and is now 1,480 feet deep. The new level at 1,300 feet has cut no ore, but has developed a very fine showing of leached ground, and the 1,400-foot level has been started. The most important ore developments were on the Sunnyside and Jesse Glencairn claims. The Sunnyside is reported to have developed much ore. On the Jesse Glencairn claim a large ore body has been developed on the 1,100-foot level. Ore bodies have been cut on the Supplement and Election claims on the 1,000-foot level. A body of high-grade oxide ore was opened on the Disowned claim at the 1,000-foot level. The Briggs shaft now has a total depth of 1,271 feet, and the new level, the 1,100-foot, was driven during the year north and south from the shaft, entering long stretches of leached and copper-stained ground. The Junction shaft has been sunk to a depth of 1,348 feet, and during the year a new level, the 1,200-foot, was driven. During the last part of the year the drift northeast of the shaft on the 1,200-foot level developed a body reported to be sulphide ore of high grade. On the 770-foot level the new body of oxide ore about 250 feet west of the shaft is reported to be rich. The Hoatson shaft has attained a depth of 1,427 feet. The opening of the 1,200-foot level was started during the year, and fine oxide and sulphide ore bodies have been reported. The expense for pumping has been heavy, as the Hoatson, Junction, and Briggs shafts have been sunk. All of the water from these shafts is now raised to the surface through the Junction shaft. The production of the Superior and Arizona property consisted of 111,710 dry tons of ore smelted, which yielded 55,465 ounces of silver and 9,602,553 [a] pounds of copper. In the vicinity of Bisbee the Calumet and Arizona and the Superior and Pittsburg Copper companies have carried out the policy of providing a desirable location where the employees of the companies can secure sites for homes at reasonable prices. With these improvements in view, the Warren Company was organized in November, 1906, with both of the companies as large stockholders. An electric railway is operated by this company from the city of Bisbee to the town site of Warren.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

The Shattuck and Arizona Copper Company produced ore principally from the levels at 700, 800, and 900 feet, and made shipments to the Copper Queen smelter at Douglas until that plant was compelled to reduce its output. Thereafter, until November, 1907, the sulphide ore produced was shipped to the Old Dominion smelter at Globe, and the oxidized ore was held at the mine. The shipments averaged during part of the year between 300 and 400 tons per day and aggregated in value $1,018,512 for the copper content of 5,091,542 pounds.[a] A vertical shaft has been sunk to the 900-foot level. Although the company received bids for the erection of a smelter having a capacity of 800 tons and selected a new smelter site at Douglas, nothing further was done.

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[a] Statement of gross product for the year 1907 published by the auditor of the Territory, 1908.

The Copper Queen Consolidated Mining Company has been carrying out plans made in 1906 for a power plant, for the installation of underground electric cars for carrying ore from the stopes to the main hoisting shaft of the Sacramento, and for the hoisting of this ore by means of skips to a distributing plant on the surface. It is expected that the system will economize on mining costs and allow the extraction of lower grade ore. During 1907 the Copper Queen has continued with a normal extraction of ore, which aggregated in value $13,694,106 [a] for 66,916,972 pounds of copper, 4,197.28 ounces of gold, and 338,723 ounces of silver. The amount of exploration and development work, however, has been largely increased, particular attention being devoted to opening up new territory. This has included considerable work toward the Shattuck properties. Both the Lowell and the Sacramento shafts have been deepened, the Lowell shaft being now more than 1,400 feet in depth; and the Sacramento shaft has been sunk from the 1,000-foot to the 1,200-foot level.

Yellowstone district.—Several small shipments were made from different properties during the year, but the most important developments were carried on by the La Vantia Mining Company, which has an incline shaft 225 feet deep and about 800 feet of drifts. The property also has a 5-stamp mill equipped for amalgamation and concentration.

COCONINO COUNTY.

The Francis, the McClure, and the Grand Canyon districts join each other and the principal shipping points are Aztec and Grand View, on a branch of the Santa Fe Railway connecting Williams with the Grand Canyon. Ten properties produced mostly from shallow depths, yielding a siliceous ore largely containing carbonate but with some sulphide of copper. The Anita mine in Francis district was leased to the Arizona Smelting Company, which shipped the ore to its plant at Humboldt, in Yavapai County. The Canyon Copper Company, at Grand View, produced from its Last Chance property and shipped copper ore containing 80,989 pounds of copper and 467 ounces of silver, which aggregated $16,507 [a] in value.

GILA COUNTY.

The metal output of this county came mainly from the Globe district, which covers its principal mineral area, and partly from outlying districts, from which small quantities of ore were shipped to Globe for treatment at the Old Dominion smelter. The production of gold, silver, copper, and lead in 1907 aggregated $7,507,880 in value, which is greater by $1,879,127 than the value of the output of 1906. The tonnage of ore mined increased 29,389 tons, and the average total value per ton from $13.55 in 1906 to $16.88 in 1907. The production was reported from 41 deep mines and 1 placer in 1907. The ores mined aggregated 444,860 tons, including flue dust and old slag treated. The greater part of the ore was treated at the local copper smelting plant, while some siliceous ore for converter lining went to Cananea, Mexico, and to Douglas, Ariz. Several small shipments of lead ore went to smelting plants located at points outside the Territory. In operation were 2 concentration mills, at which 138,955 tons of copper ore were treated, producing 40,093 tons of concentrates (3.4 tons into one), containing 660.16 ounces of gold, 16,409 ounces of silver, and 6,152,715 pounds of copper. The value of the gross content of the concentrates produced in the Globe district amounted to $1,255,020, an average of $31.30 per ton of concentrate. The placer bullion consisted of 6.10 fine ounces of gold from one property located in Lost Gulch, about 4½ miles northwest from Globe. The total production of metal was as follows: 3,001.14 ounces of gold, valued at $62,039; 94,062 ounces of silver, valued at $62,081; 36,875,993 pounds of copper, valued at $7,375,199; and 161,523 pounds of lead, valued at $8,561. The yield of each metal increased, except that of silver, which was 28,036 ounces less than in 1906. Gold increased $14,123 in value; copper increased 8,383,602 pounds in quantity and $1,876,168 in value; lead, of which none was reported in 1906, increased by the output of 1907. The shipment of sulphide ore to Globe for treatment at the Old Dominion smelter has been practically discontinued, as the 1,600-foot level of the Old Dominion mine now affords sufficient sulphide ore, thus reducing the cost and benefiting smelting operations.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Globe district.—The Old Dominion Copper Mining and Smelting Company operated its mine, concentrator, and smelter the entire year. The value of the output was $4,754,703, for 23,294,496 pounds of copper, 2,407 ounces of gold, and 69,067 ounces of silver.[a] Production during the latter part of the year was curtailed to some extent by discontinuing one furnace of the smelter in November. During the first part of 1907 a shortage of fuel restricted operations. A large tonnage of custom ore was handled at the smelting plant and some low-grade copper ores from adjoining properties were put through the concentrating mill. At the close of the year the company was operating 4 furnaces, 2 of which were running entirely on old slag from the dump, which contains 2.5 per cent copper. The company is hoisting daily 350 tons of concentrating ore and 250 tons of smelting copper ore. The output from its smelter is over 2,000,000 pounds of copper per month, 70 per cent of which is derived from its own ores. No. 1 vein, recently opened at the sixteenth level, is stated to carry a good grade of ore for a width of 15 feet. A part of this is sulphide ore, which fills a long-felt want, as the sulphur in the ores formerly mined was not sufficient to permit the making of a low-grade matte for proper converting.

The Inspiration Mining Company, owning 23 claims, is developed by the Mercer and Woodson adits, and has gained a depth of 350 feet from the surface. The company owns a concentration plant, which treats 50 tons of ore daily and which operated during a part of the year producing concentrate which was shipped to smelters at Globe,

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Ariz., and at El Paso, Tex. The Keystone Copper Company owns property 8 miles west of Globe. Its 15-ton electrolytic experimental plant, which was in operation during 1906, did not prove a success, and during 1907 all of the ore from this mine was shipped to the Old Dominion smelter and used as converter lining. This ore contained 208,801 pounds of copper and aggregated in value $41,768.[a] The Live Oak Copper Mining and Smelting Company, adjoining the Keystone Company on the south, shipped a large tonnage of siliceous copper ore from surface workings to Globe, El Paso, Douglas, and Cananea. The ore was valued at $117,692 for its copper content of 588,347 pounds.[a] The mine is opened by a number of shafts and levels driven from the surface. The underground workings will aggregate 5,000 feet. The Apache Consolidated Copper Company operated the Alice and Little Arthur claims, which are developed by shafts and drifts, and shipped to the Old Dominion smelter during 1907. Development work consisted of retimbering the shafts and driving the surface level on the Alice claim 60 feet. The Gibson Copper Company, during part of the year, shipped monthly to the smelter about 250 tons of sulphide ore, which aggregated in value $668,289 for 3,340,777 pounds of copper.[a] A new compressor and hoist were added to the equipment. The Warrior Copper Company shipped crude ore to the Old Dominion smelter. No report is made of operations with its 100-ton concentrating mill. The output aggregated in value $279,790 for 1,397,612 pounds of copper and 325 ounces of silver.[a] The company has expended about $1,000,000 on the property, most of it in the construction of a plant and other improvements on the surface, including a leaching plant, sulphuric-acid plant, and smelter. Unfortunately the surface ore was found unsuitable to the leaching process. Shipments have been made from the Montgomery claim of this company for the last three years, in which time a large high-grade ore body on the 250-foot level has been developed. The Pinto Creek Mining and Smelting Company produced from its property and tested ore in its concentrating mill. The incline shaft on the property is 570 feet deep. The Arizona Commercial Copper Company, operating the Copper Hill and Black Hawk properties, has sunk its vertical shaft on the former a depth of 800 feet and an incline on the latter 500 feet. The new 3-compartment shaft on the Eureka claim has been sunk to a depth of 100 feet. The total output, valued at $328,861, consisted of 1,638,610 pounds of copper and 1,644 ounces of silver.[a] The Arizona and Eastern Consolidated Mining Company, which operates the Contact group, has a double compartment shaft sunk a depth of 165 feet. The United Globe Mines Company developed its property by a vertical shaft 640 feet deep, with several miles of drifts and crosscuts. Since it is not equipped with a reduction plant, all of its low-grade ore goes to the Old Dominion concentrator, and the concentrate, as well as the crude ore, is sold to the Old Dominion smelter. The property consists of 41 claims. The total development work for the year was 7,141 feet, consisting of 3,406 feet of drifts, 2,308 feet of crosscuts and 1,427 feet of raises. The total output was valued at $688,040 for 3,399,084 pounds of copper and 12,382 ounces of silver.[a] The Eureka Copper Company, owning 8 claims, shipped siliceous copper ore taken from surface workings; much of this was used for converter lining at the Globe and Douglas smelters. A strong vein of 8 per cent copper ore has been reported to be opened to a depth of 150 feet. The Globe Arizona Copper Company, owning the Rolling, Rogers, and Star groups, made some shipments of ore to the Old Dominion smelter, which aggregated in value $11,730 for 57,231 pounds of copper and 430 ounces of silver.[a] The development work on the property consists of a level run from the surface 115 feet long, with drifts, and a winze sunk 77 feet, reported to be entirely in ore, which averaged in the neighborhood of 5 per cent of copper and 2 ounces of silver per ton. The Radium Mines Company shipped about 8 cars of lead ore, the latter part of the year, containing copper and silver with a trace of gold.

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[a] Statement of gross product for the year 1907 published by the auditor of the Territory, 1908.

Houdan district.—The Producer claim, on which there is installed an arrastra of a daily capacity of 1 ton, was operated, and some bullion was shipped.

Lost Gulch district.—The Lost Gulch Gold Milling and Mines Company owns a number of claims, as well as a 10-stamp mill, equipped for amalgamation and concentration. Tests were made on the ore.

San Carlos district.—The Saddle Mountain Mining Company operated its mine and matting furnaces until September, 1907, shipping the matte to the Humboldt smelter in Yavapai County. The output was valued at $360,460 for 1,751,264 pounds of copper, 254.89 ounces of gold, and 7,454 ounces of silver.[a] The property is opened by shaft and levels driven from the surface. The deepest shaft is 420 feet deep. In the underground workings good bodies of sulphide ore, mainly chalcopyrite, have been developed, and are said to average about 3 per cent of copper. This ore is entirely self-fluxing, carrying about 20 per cent of excess basic matter. The ore is in the altered limestone along porphyry contacts and often extends out a good distance from the porphyry. The matting furnaces at Christmas handled on an average of about 200 tons of ore per day. The plant ceased operations when the panic came on and the smelter purchasing the matte closed.

GRAHAM COUNTY.

Production of gold, silver, and associated metals in Graham County, Ariz., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	2,699.76	$55,809	1,476.07	$30,513	− 1,223.69	− $25,296
Silver ....do....	130,904	87,706	87,578	57,801	− 43,326	− 29,905
Copper ....pounds..	59,270,459	11,439,199	62,720,962	12,544,192	+3,450,503	+1,104,993
Lead ....do....	221,600	12,631	14,142	750	− 207,458	− 11,881
Total.................	....	11,595,345	....	12,633,256	....	+1,037,911

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Source of gold and silver in Graham County, Ariz., in 1906 and 1907, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Copper-lead ore.	Total.
Gold	1906	....	409.10	2,237.09	53.59	2,699.78
	1907	19.98	228.71	1,225.27	2.11	1,476.07
Silver	1906	....	21,089.00	107,045.00	2,770.00	130,904.00
	1907	3.00	22,596.00	64,859.00	120.00	87,578.00

In 1907 Graham County made substantial gains in its tonnage of ore mined and copper produced, but gold, silver, and lead show decreased production as compared with that of 1906. The gold output amounted to $30,513 in 1907, as against $55,809 in 1906, while the silver output decreased from 130,904 ounces in 1906 to 87,578 ounces in 1907. The lead with other metals was contained in ore mined outside the copper-producing district. Copper showed an increase from 59,270,459 pounds in 1906 to 62,720,962 pounds in 1907. This increase was largely due to the enlarged operations of the Shannon smelter, which increased its mine output and bought ore from other properties. Production was reported from 34 deep mines and 1 placer. The deep mines produced 1,418,499 tons of ore in 1907, as against 1,259,161 tons in 1906; an increase of 159,338 tons. The total average value per ton decreased from $9.21 in 1906 to $8.91 in 1907. This resulted from the fact that one of the larger companies took advantage of the high price of copper to treat the lower grade ore from its mine. Ores treated at smelting plants aggregated 154,306 tons, including some old slag resmelted, and contained 1,054.76 ounces of gold, 73,215 ounces of silver, 15,547,285 pounds of copper, and 14,142 pounds of lead, amounting in total value to $3,180,333, an average per ton of $20.61. The lead was contained in ore shipped to outside custom plants. Ore to concentration mills aggregated 1,264,113 tons, resulting in 193,068 tons of concentrates containing 361.79 ounces of gold, 14,357 ounces of silver, and 47,173,677 pounds of copper, which amounted to $9,451,690 in value and averaged $7.48 per ton of crude ore. At one gold and silver mill a small quantity of ore was treated as a test.

Ash Peak district.—The Ash Peak Mining Company operated the Commerce and Shamrock claims and shipped to smelters ore containing a high percentage of silica for converter lining. The output was valued at $11,898 for its silver content of 18,214 ounces.[a]

Bunker Hill district.—This district is located in the Galurio Mountains. Country rocks are limestone and porphyry.

On the claims of the Copper Creek Mining Company, embracing an area of 680 acres, important development work was performed in opening up the 2 veins that traverse the property. One test shipment was made to the smelter, and indications are that regular shipments will be made during 1908. The Southern Pacific Railway is 60 miles distant, but the Phoenix and Eastern, now part of that system, will pass within 12 miles of the mines.

Copper Mountain and Greenlee districts.—The New York and Arizona Gold and Copper Company, operating the Buzzard's

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[a] Statement of gross product for the year 1907 published by the auditor of the Territory, 1908.

Shadow and 30 other mining claims, developed the properties to some extent and made one small shipment of ore, which was mined by lessees from the Buzzard's Shadow claim. This property adjoins the Gold Belt group, which was a regular producer during 1907, and is under the management of the Gold Belt Development and Reduction Company. Development work consisted of 3,000 feet of drifting during 1907. There are 2 shafts, the deepest of which is 285 feet. On one of this company's properties excellent copper ore has been developed and shipments were made regularly during the year. The Detroit Copper Mining Company of Arizona, in its improvements made during 1907, has saved considerable money in the handling of ore and is also making a higher saving of copper. In October the concentrating mill treated an average of 1,100 tons of ore daily. The latter part of the year, owing to scarcity of water, the tonnage of ore treated was diminished. The output aggregated in value $3,476,660 for 17,346,411 pounds of copper, 176 ounces of gold, and 4,814 ounces of silver.[a] The Clifton Gold and Copper Company took over the Katydid group, which has been a small producer in the past, and other groups from which shipments were made to the Shannon and Douglas smelters. On all of the properties considerable development work has been performed. The Silver King claim was a producer of siliceous ore, which was shipped to different smelters for use as converter lining. The shipments averaged about 12 ounces of silver and 0.1 ounce of gold per ton. Other claims from which ore was shipped for converter lining were the Tejo-Viejo, Chavez, and Capote.

In the southern part of the Greenlee district, at Gold Hill, the Crawford Gold Mining Company operated an experimental mill, equipped for amalgamation. The company contemplates erecting a plant to treat the ore by the cyanide process, as that has been found more favorable than any other. Some bullion was shipped as a result of the experiments. The Arizona Copper Company operated its smelting plant and concentrator during 1907 without any apparent curtailment in the output. The concentrators for making a sulphide concentrate have a capacity of 2,100 tons of ore daily, and in addition about 400 tons of oxidized ore are concentrated in a Hancock jig, which is proving itself valuable for this class of work. The output was valued at $6,160,050 for 30,794,092 pounds of copper.[a] The Stevens Copper Company owns 48 claims on Chase Creek, extending from west of American Mountain to the region east of Metcalf and north of the San Francisco River. Two test lots of copper ore were shipped to the smelter. The Cliff group of claims produced some copper ore, which was shipped to the Shannon smelter. The New England-Clifton Copper Company of Arizona, operating the Copper King and Antietam claims, curtailed operations in September, 1907. The output aggregated in value $410,397, for 1,981,189 pounds of copper, 62.42 ounces of gold, and 19,578 ounces of silver.[a] The published statement of the operations of the company for the year ending June 30, 1907, gives the total tonnage of ore treated as 10,388, on which net smelter returns of $210,867 were received. The tramroad, which has a total length of 5,200 feet, connecting with the Wiseman adit of the Shannon mine, is well situated for handling the ore at low cost. The property has been shipping an average of 1,500 tons monthly. The development work will aggregate 10,000 feet. Ten, of 100 mining claims located, are patented. The Standard Consolidated Copper Company made shipments of low-grade copper ore to the smelters. This ore was utilized chiefly for converter lining. The property is developed by 3 levels run from the surface and aggregating 959 feet, of which 476 feet were accomplished in 1907. The ore mined yielded 78,097 pounds of copper and 4,717 ounces of silver, valued at $18,704.[a] The Clifton Copper Mines Company (Limited) made substantial shipments of copper ore. Its property is developed by an incline shaft 314 feet deep. This shaft was sunk 142 feet during 1907, with drifts and crosscuts aggregating 320 feet.

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[a] Statement of gross product for the year 1907 published by the auditor of the Territory, 1908.

The Shannon Copper Company, which has a concentrating mill of a daily capacity of 500 tons and a smelter for treating 1,800 tons of ore daily, operated the entire year without any apparent curtailment in the output. There was extracted from the Shannon mine 211,857 tons of ore during the fiscal year ending with August. There were treated at the reduction works 209,654 tons. The ore extracted from the mine came mainly from the east and west ore bodies, so designated by the company. The development consisted of 14,610.5 feet. The cost of production during the year was materially increased by the high wages paid in the district. The cost of supplies, including lumber, also increased the cost per pound of copper extracted. The ore in the Shannon property occurs in the shape of large lenticular bodies, similar to the Detroit and the Arizona Copper companies' deposits. These deposits have shown great persistence and in every case have proven to extend for a much greater area than was originally expected. The output aggregated 10,874,619 pounds of copper, 950.23 ounces of gold, and 34,037 ounces of silver, valued at $2,217,735.[b] The Standard Copper Mines Company owns 990 acres. The property is developed by a vertical shaft 150 feet deep and by 1,275 feet of crosscuts. The output consisted of 497,286 pounds of copper, valued at $99,477.[b]

Lone Star district.—The Lone Star Consolidated Copper Company has sunk on its property a vertical shaft 150 feet deep, with crosscuts, and an incline shaft 500 feet deep, on which sinking is being continued. The company made one test shipment of copper ore. The Arichise Copper Company owns the Buena Vista group, which is situated 7 miles north of Solomonville, in the Gila Mountains. The ore contains copper, but no gold or silver. The Gila Valley Copper Company developed its property near Stafford to a depth of 230 feet by vertical shaft and shipped copper ore and concentrates to Globe during 1907. This ore aggregated in value $22,732 and contained 110,858 pounds of copper, with 6 ounces of gold and 233 ounces of silver.[b]

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[a] Statement of gross product for the year 1907 published by the auditor of the Territory, 1908.

[b] Statement of gross product for the year published by the auditor of the Territory, 1908.

MARICOPA COUNTY.

The high price of metals during 1907 brought out a number of small lots of crude ore which were shipped to the smelters by a number of companies. The districts producing were the Agua Fria, San Domingo, Vulture, and White Picacho.

The greatest amount of development work was accomplished in the Agua Fria district by the Relief Gold Mining Company, which produced mill bullion containing gold valued at $10,522,[a] the result of ore taken out in development work. The incline shaft still remains at a depth of 500 feet, and the 200-foot level is driven 700 feet to the west, and the 300-foot level 550 feet in the same direction. The mill has a capacity of about 24 tons per day. It was only operated part of the year.

MOHAVE COUNTY.

The production of silver, lead, and zinc was mainly from the Wallapai district and the gold was from the Gold Road mine in San Francisco district. The output was the result of operations by 49 producers, and amounted to $825,997, less by $24,844 than the output of 1906. The tonnage of ore mined increased 4,055 tons, and the average value per ton decreased from $13.12 in 1906 to $11.99 in 1907. The ore mined aggregated 68,887 tons, which contained 28,317.90 ounces of gold, valued at $585,383; 80,897 ounces of silver, valued at $53,392; 601,210 pounds of copper, valued at $120,242; and 1,229,654 pounds of lead, valued at $65,171. The total quantities of metals won from the ores showed a decrease from the production of 1906 in gold of 2,692.11 ounces, valued at $55,651; in silver of 64,282 ounces, valued at $43,878; but an increase in copper of 285,218 pounds, valued at $59,256, and in lead of 325,255 pounds, valued at $13,620. Zinc is an addition to the output in 1906 and came from 1 property. At concentration mills 9,572 tons of ore were treated, producing 944 tons of concentrates, which contained 1,544.03 ounces of gold, 14,355 ounces of silver, 1,102 pounds of copper, and 106,835 pounds of lead, valued at $47,275, an average of $50.08 per ton. At gold and silver mills 54,605 tons were treated, including old tailings, which yielded 25,212.98 ounces of gold, and 14,230 ounces of silver, valued at $530,590, an average of $9.71 per ton. Crude ore shipped to smelters amounted to 4,710 tons, containing 1,560.91 ounces of gold, 52,312 ounces of silver, 600,108 pounds of copper, and 1,122,819 pounds of lead. Zinc contained in crude ore came from 1 property. The total value of ore smelted was $248,132, an average of $52.68 per ton. Mine development has been active in all districts of the county, and in some mines the producing stage had not been reached before the panic came on, which closed a large number of the enterprises or retarded the work. The Tom Reed Mining Company has taken over the Blue Ridge mine in the San Francisco district, and is putting the mill on the property in shape to operate. Near this property is the Victor-Paymaster, which will have its mill in operation early in 1908; and in the same region the German-American Mining Company expects to resume operations with additional equipment to its mill. In the Union Pass district development is being performed on a large zinc deposit, from which it is intended to make shipments in 1908. The smelter, treating most of the Mohave County lead ore and some copper ore, is situated on the Colorado River at Needles, Cal. The plant is the property of the Arizona-Mexican Mining and Smelting Company, which owns and operates mines in Mohave County and at Siam, Cal. This smelter is designed for treating ores from the company's mines, together with custom ores. The equipment consists of 1 lead blast furnace, and 1 copper furnace, of a capacity of 100 tons each, 1 No. 6 Hart-McDougall roasting furnace, and a sampling plant. Oil fuel is used for generating steam and for ore roasting. Limestone and iron ore are found in abundance in close proximity, and labor conditions are favorable.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Bentley district.—The Grand Gulch Mining Company, up to the close of the year, continued shipments of copper ore from its property, located 65 miles southeast of Moapa, Nev., which continues to be the shipping station on the San Pedro Railroad. The vertical shaft on the property is 425 feet deep. Shipments of copper ore were also made from the Savanic mine in the same district.

Cedar district.—The Benedictine Mining and Milling Company, operating the Cedar Valley Group, made a number of improvements on the property. It is equipped with an amalgamation, concentration, and cyanide plant of a daily capacity of 150 tons. Late in the year the properties closed down on account of litigation. The Yucca Cyanide Mining and Milling Company, owning the San Francisco group, operated its 10-stamp mill, equipped for concentration, amalgamation and cyanide, during part of the year. The company shipped some concentrates, the result of experiments. The mine is developed to the 600-foot level.

Cottonwood district.—The Tawa Development Company has its deepest shaft down 182 feet, and shipped 181 tons of copper ore from its Copper Giant property during the time of development. The ore contains copper, silver, and gold.

Hackberry district.—Several shipments of ore were made from this district during 1907 from prospect dumps and tailing workings.

San Francisco district.—From the vicinity of Vivian, several small test shipments of ore were made, but the most important operations continued to be at Gold Roads, where is located the large milling plant and mine of the Gold Roads Mining and Exploration Company. The output in 1907 was valued at $453,209, for 21,597.36 ounces of gold and 10,397 ounces of silver.[a] The shaft on the property has been sunk to a vertical depth of 835 feet, and it is reported that the ore shoot 7 feet in width, averaging well in gold, was cut in December on the 800-foot level. The power plant, which was being erected at Kingman, is not completed. The company contemplates increasing the capacity of the milling plant, which is at present equipped with six 5-foot Huntington mills and a cyanide plant, allowing for the treatment of 175 tons of ore daily. The property is controlled by American and French interests. The Victor Paymaster Mining Company purchased during 1907 the Paymaster mine, which is reported as having produced in the past values of $200,000 in gold and silver, chiefly in the latter. The new owners are enlarging the shaft and retimbering the old workings. While sinking the shaft a new ore shoot was encountered. A milling plant is under construction and, when completed, will be electrically operated by the Needles electric power plant. The water for the plant is pumped from Spear Lake, 9 miles distant.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Wallapai district.—A large number of small shipments of ore, containing lead, copper, silver, and gold, were made to the smelters at Needles and Humboldt during the period of high metal prices. One of the most important shippers for the year was the Cerbat Mountain Mining Company, producing ore and concentrates containing gold, silver, and some lead. The company shipped bullion to the mint and ore to the Needles smelter. The development on the property comprises an incline shaft 250 feet deep and a drift run from the surface 300 feet long. Some experimental work was carried on in the 20-ton concentrating mill with a magnetic separator. The output, valued at $14,329, was from 655.02 ounces of gold and 1,209 ounces of silver.[a] Important developments on the Pinkham mine allowed the shipment of a large tonnage of ore containing copper, gold, and silver. The property is developed to a depth of 250 feet by a vertical shaft. The Arizona-Mexican Mining and Smelting Company, operating the Champion and Banner mines, shipped crude ore and concentrate. The Banner property is equipped with a concentrator with a daily capacity of 50 tons. The output, valued at $63,149, contained 383.82 ounces of gold and 12,290 ounces of silver, with lead making up the balance of the total value.[a]

The Samoan group, operated by the Chloride Gold Mining Company, shipped to the Needles smelter a good grade of lead ore, containing gold and silver. The shaft on the property is 335 feet deep. The output, containing lead, was $11,518 from 408.7 ounces of gold and 4,700 ounces of silver.[a] The Hercules mine, which is developed by a 100-foot shaft, is equipped with one crusher and a 2-compartment jig, and from it was shipped lead ore and concentrate, containing gold and silver. The Gem mine, operated by the Golden Star Mining and Milling Company, opened its incline shaft to a depth of 430 feet, and used its mill, which is equipped with 4 Nissen stamps, plates, and concentrating tables. The shipments consisted of a concentrate and gold and silver bullion, aggregating in value $44,888, for 1,962 ounces of gold and 6,634 ounces of silver.[a] The Wallapai Mining and Development Company leased the dump of the Tennessee mine. A concentrate was produced by jigs and electrostatic separators. Various trials were made to produce a grade of zinc concentrate which would bear shipping to the eastern zinc plants.

Weaver district.—The tailings dump, of the old Klondyke mill near the Colorado River, was entirely worked over by cyaniding during 1907, and yielded precipitates, which were shipped to a smelter at San Francisco. The Dandy group of claims, locally known as the Hall mine, is equipped with a mill, comprising a Dodge crusher and Chilian rolls, apron plate, and 1 concentration table. The mill has a capacity of 12 tons in twenty-four hours, and in its operation some gold and silver bullion was produced in 1907. The incline shaft on the property is 220 feet deep, and in addition there are about 900 feet of drifts and crosscuts.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

PIMA COUNTY.

The ore mined aggregated 57,539 tons, valued at $1,427,412, which, with the placer yield, amounted to $1,436,254. This output was reported by 44 producers, of which 2 were placers. Crude ore shipped to smelters, aggregating 57,189 tons, was 99 per cent of the county output, and contained 60.08 ounces of gold, 103,251 ounces of silver, 6,685,384 pounds of copper, and 291,580 pounds of lead; valued at $1,421,989, an average of $24.86 per ton. There were 350 tons of ore to gold and silver mills, from which was extracted bullion containing 120.93 ounces of gold and 71 ounces of silver, and 35 tons of concentrate containing 41.86 ounces of gold, 2,348 ounces of silver, 316 pounds of copper, and 8,850 pounds of lead. The crude ore was valued at $5,494, an average of $15.69 per ton. The placers are located in Greaterville and Quijotoa districts. The output of placer gold increased from 281.76 ounces in 1906 to 425.70 ounces in 1907. The total quantities of metals won from the ores showed an increase over those of 1906 in each metal, except gold, the output of which was $6,793 less in value in 1907 than in 1906. Silver increased 18,530 ounces in quantity and $11,357 in value; copper, 454,922 pounds in quantity and $134,600 in value, and lead 251,542 pounds in quantity and $13,136 in value. The operation of the smelting plant of the Southern Arizona Smelting Company, at Sasco, should increase the metal output very materially in 1908.

Ajo district.—A number of small shipments of copper ore were sent to the smelter from several properties, mined principally by lessees. As the Cornelia and Ajo mines are 50 miles distant from the Southern Pacific Railroad, shipments of ore under a certain grade can not be made; the ore deposits in the district, however, are reported to be large, and reduction plants have been contemplated, which will profitably handle them.

Amole district.—The Gould Copper Company has a shaft 165 feet deep and also 1,000 feet of drifts and crosscuts on the property. The company made a number of shipments of copper ore to the Globe smelter during 1907, which aggregated in value $9,009 for 45,036 pounds of copper.[a] The Old Pueblo mine and the Purcell group are being developed by the Tucson Consolidated Mining Company. A shipment of ore was made during development work. The Acme Mining and Reduction Company shipped a test lot of copper ore which was taken out in development.

Arivaca district.—The Cerro-Colorado Mining and Milling Company has developed its Silver Queen property with a vertical shaft 520 feet deep, and has about 3,000 feet of drifts. The Yellow Jacket claim was productive of some ore. Its shaft is 100 feet deep.

Comobabi district.—The Papago Copper Company shipped ore containing copper, gold, and silver. Development on the property consists of 600 feet of drifts.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Empire district.—The Total Wreck property, owned by the Empire Mining and Development Company, and the Verde Queen Mining Company both made shipments of ore containing copper, lead, and silver.

Helvetia district.—The most important mine operated in the district is that of the Helvetia Copper Company. The property is opened by 2 shafts. The Isle Royale shaft has been sunk to a depth of over 1,000 feet. In its upper levels a large body of low-grade ore is opened up. The Copper World incline shaft is sunk 200 feet and is being continued. The 200-ton copper matting furnace with which the property is equipped was closed down early in 1907. The output of 1907 was valued at $39,387, and consisted of 191,666 pounds of copper, 6.56 ounces of gold, and 1,394 ounces of silver.[a] Other properties producing and shipping are the Omega, Tip Top, Green Monument, Cuprite, Blue Jay, and Narragansett.

Pima district.—Numerous small shipments were sent out of this district during 1907, but the most important ones were from the Plumed Knight, the Gray Copper, the Mineral Hill, and the Paymaster properties. The most important production was made from the Morgan group, owned by the Twin Buttes Mining and Smelting Company, which has developed the property to the 500-foot level. The company shipped regularly to the smelters at El Paso, the total output aggregating in value $19,038 for 94,056 pounds of copper and 342 ounces of silver.[a] The same interests have built a railway line 27 miles long, connecting Tucson with the camp. The Swastika Copper and Silver Mining Company developed its Pioneer and Alice claims by an incline shaft 160 feet deep. The ore contains lead, copper, and silver. The Paymaster Consolidated Mines Company is developed by a series of shafts along the vein for a distance of 3,600 feet. Shaft No. 4 is 325 feet deep, and is the main shaft from which most of the ore shipped in 1907 was extracted. The ore carried lead, copper, and silver, valued at $25,913, and, besides the lead, contained 4,735 pounds of copper and 20,000 ounces of silver.[a]

Quijotoa district.—The property of the Weldon Gold and Copper Company is equipped with a mill of a daily capacity of 50 tons, which uses amalgamation and concentration. Some concentrate was shipped from this property during the year, and placer gold was extracted from the gravels by dry-washing machines.

Santa Catalina district.—The Pontotoc Copper Company shipped copper ore, which was taken out during development work. The ore averaged 5 per cent of copper, 37.5 per cent of silica, 12.4 per cent of alumina, 19 per cent of iron, and 12.5 per cent of lime. The output, valued at $18,121, was for 92,189 pounds of copper.[a]

Silver Bell district.—The principal property operated in this district is that of the Imperial Copper Company. The mine is developed by 2 vertical shafts, 700 and 450 feet deep. An incline shaft sunk at an angle of 45° is 1,200 feet deep. During 1907 the 300-ton smelter and the 300-ton concentrating mill were in course of construction. The ore produced from this property was shipped to Douglas, Ariz., and El Paso, Tex., and aggregated in value $1,094,957 for 5,267,401 pounds of copper and 63,170 ounces of silver.[a] The El Tiro Copper Company shipped ore valued at $13,607 for 68,023 pounds of copper.[a] The Oxide Copper Company's output, valued at $66,111, was for 319,591 pounds of copper and 3,338 ounces of silver.[a]

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

PINAL COUNTY.

The value of the total output of this county amounted to $281,482 in 1907. The total represents 1,412.31 ounces of gold, valued at $29,195; 21,036 ounces of silver, valued at $13,884; 1,191,322 pounds of copper, valued at $238,264; and 2,624 pounds of lead, valued at $139. The production was reported from 30 deep-mine producers and 2 placer mines. The tonnage amounted to 19,911 tons, of which 5,711 tons were shipped crude to the smelter. This tonnage of crude ore shipped to smelters contained 265.51 ounces of gold, 20,026 ounces of silver, 959,723 pounds of copper, and 2,264 pounds of lead, valued at $210,769, an average of $36.91 per ton. At concentration mills 8,541 tons of ore were treated, which yielded 481 tons of concentrates containing 0.27 ounces of gold, 650 ounces of silver, 231,599 pounds of copper, and 360 pounds of lead, valued at $46,774, or an average of $97.25 for each ton of concentrates. At gold and silver mills 5,659 tons of ore were treated yielding bullion, which contained 1,125.06 ounces of gold and 355 ounces of silver, valued at $23,491, an average of $4.15 per ton.

Casa Grand district.—Important shipments were made from a number of properties in the district. On the Copperosity Mining Company's property the vertical shaft is 278 feet deep, an incline shaft is 122 feet deep, and prospecting surface drifts aggregate 450 feet in length. The quantity of copper produced amounted to 72,698 pounds, valued at $14,542.[a] The Casa Grand Mining and Smelting Company produced 86,344 pounds of copper, valued at $17,274.[a] Early in the year the Desert Queen Gold Mining Company ceased operations with its experimental plant, consisting of an equipment of two Tremain stamps, which were capable of treating 20 tons of ore per day.

Mineral Creek district.—A number of producers were reported for this district in 1907, the most important one being the Kelvin-Calumet Copper Mining Company. There are 2 plants connected with the property, 1 of a daily capacity of 65 tons and a stamp mill of a daily capacity of 40 tons. When the properties, the Big Lead and the Calumet Copper Mining Company, were consolidated it was planned to enlarge the stamp-mill to 25 stamps, thus allowing for a treatment of 200 tons of ore per day. On the Kelvin property the shaft is sunk a depth of 325 feet. Development work in 1907 consisted of 100 feet on the shaft and 2,100 feet of drifts. All work ceased at the time of the panic, and the production up to this time for 1907 was 178,516 pounds of copper, valued at $35,710.[a] The Copper Butte Mines Company, which was formerly the Arizona Copper

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Mountain Mining Company, has opened its property by a level driven from the surface, now 300 feet long. It has several incline shafts, the deepest of which is 450 feet. The ore produced contained principally copper.

Old Hat district.—The Mohawk Gold Mining Company's property, located 12 miles east of Oracle, is developed to a depth of 526 feet with a vertical shaft, 200 feet of which was sunk during the year. The ore produced contained gold and silver, and was tested in the 30-stamp mill equipped for amalgamation and concentration belonging to the company. The production consisted of 1,151 ounces of gold and 177 ounces of silver, valued at $23,907.[a] The American Flag claim, now known as the Gideon, produced some ore containing an average of 18 per cent of copper and some silver. This was taken out in development work from the incline shaft, which is 160 feet deep. The property is equipped with a 3-stamp Merrill mill and concentrator. Thirty-one claims comprise the group, which lies about 7 miles southeast from Oracle.

Pioneer district.—The Lake Superior and Arizona Mining and Smelting Company at Superior has an incline shaft 1,640 feet deep, with 3 adits—1,021, 2,766, and 500 feet long, respectively. The production consisted of 92,120 pounds of copper, 188.85 ounces of gold, and 1,041 ounces of silver, valued at $23,011. The Queen Copper Mining Company, leasing the Queen group of claims, mined from the 300-foot level in the neighborhood of $30,000 worth of ore, containing copper, silver, and some gold. The Coughlin claim of the American Copper Company and the Eureka Claim were also producers.

Riverside district.—This district was quite productive in the number of shipments of ore. The largest tonnage of ore mined and shipped out of the region came from the Riverside and Bryan group of the Sultana Arizona Copper Company and the Troy Manhattan property near Kelvin. The former produced 45,838 pounds of copper and 653 ounces of silver, with a total value of $9,595.[a]

Saddle Mountain district.—The Central Mining and Development Company, owning the Two Queens mine, has a level driven from the surface completed for a distance of about 350 feet. Small test shipments of ore and concentrates were made during 1907.

SANTA CRUZ COUNTY.

The total ore output of 1907 was 15,145 tons, valued at $173,019, reported by 21 producers in 5 districts. This is an increase of 16 producers and a decrease of 106,904 tons of ore as compared with the corresponding figures of 1906. The gold produced amounted to 137.72 ounces, valued at $2,847; the silver to 49,674 ounces, valued at $32,785; the copper to 504,254 pounds, valued at $100,851; and the lead to 625,861 pounds, valued at $33,171. Of the ore mined, 4,278 tons were shipped crude to the smelters and contained 30.81 ounces of gold, 38,033 ounces of silver, 495,258 pounds of copper, and 197,461 pounds of lead, valued at $135,257, an average of $31.61 per ton. Concentrates were produced and shipped to smelters, amounting to 1,284 tons, extracted from 10,775 tons of crude ore. The concentrates contained 31.8 ounces of gold, 11,392 ounces of silver, 8,996 pounds of copper, and 428,400 pounds of lead and zinc, the quantity of each of which is not disclosed, as it was shipped by one property. The concentrates aggregated in value $36,045, an average of $28.07 per ton. A small quantity of gold and silver bullion was produced at 2 mills equipped for amalgamation.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Oro Blanco district.—The Golden Eagle group and the Yellow Jacket Mining Company were producers of small quantities of ore containing gold and silver.

Palmetto district.—The Lead Carbonate claim was productive of some lead ore, carrying silver.

Patagonia district.—The principal operations were carried on by the Duquesne Mining and Reduction Company, which operated the Duquesne group. The company has recently taken under option the Pride of the West Mining Company's property, and has been making extensive tests with a 50-ton reverberatory furnace and a 100-ton concentrating mill, with which the property is equipped. The combined output of these properties, consisting of silver, lead, copper, and zinc, had a gross value of $95,661.[a] The Morning Glory claim was productive of copper sulphide ore, valued at $13,371, for 54,486 pounds of copper and 3,788 ounces of silver.[a] The claim is developed by an 80-foot incline shaft with 150 feet of drifts. The National Consolidated Mining Company, operating the Erin property, is making extensive tests in seeking some method of treating the ore economically. The ore shipped contained lead, gold, and silver. The Santa Cruz Mining and Smelting Company, the owner of the Mowry mine, operated its concentrating plant and shipped a considerable tonnage of concentrates and crude ore containing lead, silver, and gold. Development was continued during the latter part of the year in sinking the shaft to the 800-foot level. The output of the World's Fair mine amounted to $74,210,[a] and the metals produced were lead, copper, gold, and silver.

Tyndall district.—The Rosario claim was productive of some ore, carrying copper and silver. The claim is developed by a vertical shaft 100 feet deep and a tunnel 140 feet long. The Alto Copper Company has a shaft on its property 217 feet deep and an adit 1,500 feet long. The crude ore shipped contained a large percentage of lead, with gold and silver.

Wrightson district.—The Arizona Mines and Milling Company opened its property by a vertical shaft 250 feet deep. The 5-stamp mill belonging to the company was operated and produced some bullion during 1907. The Ivanhoe Mining Company is developed by a shaft 100 feet deep with crosscuts. The ore shipped contained copper and silver. The Augusta claim was also a shipper of ore containing copper and silver. The Mansfield Mining and Smelting Company has its shaft developed to a depth of 150 feet and a drift from the surface 60 feet long. It is reported that the company will equip its property with a smelter.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

YAVAPAI COUNTY.

Production of gold, silver, and associated metals in Yavapai County, Ariz., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold............fine ounces..	60,789.14	$1,256,623	55,345.94	$1,144,102	− 5,443.20	− $112,521
Silver ....do...	708,439	474,654	647,488	427,342	− 60,951	− 47,312
Copper ....pounds..	42,080,740	8,121,583	35,734,416	7,146,883	−6,346,324	− 974,700
Lead ....do....	729,787	41,598	521,307	27,629	− 208,480	− 13,969
Zinc...................do....	....	....	140,786	8,307	+ 140,786	+ 8,307
Total..................	....	9,894,458	....	8,754,263	....	−1,140,195

The origin of the precious metals, by different kinds of ore, is given in the following table:

Source of gold and silver in Yavapai County, Ariz., in 1906 and 1907, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Gold	1906	859.54	15,355.00	39,326.75	5,247.82	....	....	60,789.11
	1907	1,014.95	28,086.80	25,511.31	732.88	....	....	55,345.94
Silver	1906	119.00	24,316.00	654,108.00	29,896.00	....	....	708,439.00
	1907	164.00	117,316.00	520,049.00	9,959.00	....	....	647,488.00

Representing 25 producing districts, 117 operators reported a production from 91 deep mines and from buyers of placer gold in 11 districts. The production of gold, silver, copper, lead, and zinc in 1907 amounted to $8,754,263, or less by $1,140,195 than the output of 1906. The ore mined aggregated 375,398 tons in 1907, as against 396,788 tons in 1906, and a decrease is also noted in average value per ton from $24.89 in 1906 to $23.26 in 1907. Seventy per cent of the total ore mined, aggregating 265,190 tons, was treated at smelters, and contained 27,150.56 ounces of gold, 564,991 ounces of silver, 34,698,001 pounds of copper, and 144,502 pounds of lead, having a total value of $7,881,404, and averaging $29.72 per ton. The ore containing lead was shipped to Needles, Cal., and El Paso, Tex., while all of the copper ores were treated at the custom plant of the Arizona Smelting Company at Humboldt or at the United Verde smelter at Jerome. Concentrates were produced from 97,786 tons of ore, some of which contained gold and silver, which were extracted by amalgamation. The concentrates produced, aggregating 12,030 tons, contained 12,184.74 ounces of gold, 66,172 ounces of silver, 1,036,415 pounds of copper, and 376,805 pounds of lead. The zinc produced was shipped to Colorado plants and came from 1 property. The total tonnage of concentrates, valued at $531,115, averaged $44.15 per ton. Gold and silver mills treated 12,422 tons of ore, chiefly by amalgamation, from which was extracted bullion containing 14,995.66 ounces of gold and 16,161 ounces of silver, valued at $320,654, an average of $25.81 per ton.

Auga Fria district.—The Baumann-Copper Company developed the Laura claim from a shaft 300 feet deep. Several test shipments of copper ore were made to the Humboldt smelter. The Copper Queen Gala Mining Company has development work consisting of a shaft 350 feet deep and levels driven from the surface 630 and 300 feet, respectively. During development a small lot of copper ore was shipped as a test. The Pittsburg Mayer Mining Company, with property located 3 miles east of Mayer, made a test shipment of copper ore. The development work consists of a vertical shaft 75 feet deep and an incline shaft sunk to a depth of 60 feet.

Big Bug district.—The Arizona Exploration Company, the owner of the Blue Bell mine made regular shipments to Humboldt of crude ore, part of which was of milling grade and was treated at the Arizona Smelting Company's concentrating plant. The concentrates and crude ore produced contained copper, gold, and silver, valued at $213,531, for 922,268 pounds of copper, 784.70 ounces of gold, and 19,657 ounces of silver.[a] The George A. Treadwell Mining Company, at Mayer, owning the Hackberry, the Iron Queen, and the Boggs mines, leased the properties to the Arizona Smelting Company during the year. The ore mined was used largely as a flux, and contained small quantities of copper, gold, and silver. The deepest shaft is on the Hackberry, which is 568 feet deep. The company is equipped with a good smelting furnace of a daily capacity of 250 tons, at Mayer, but as the contracts were very favorable for shipments of ore to Humboldt, the operation of its own plant was not attempted. The total value of the output was $34,428, for 18,063 pounds of copper, 46.92 ounces of gold, and 1,157 ounces of silver.[a] The Mount Elliot Consolidated Mines Company is the new owner of the Dividend mine at Chaparal, which began producing in November, 1907. Gold and silver bullion was shipped and a number of tons of concentrates were stored until favorable rates of transportation should be made. For the month of December 414.55 tons of ore were treated, having an average gold and silver value of $16.20. The recovery amounted to $14.35 per ton, leaving in the tailings $1.85. The expenses per ton of ore for stoping and hoisting were $2.15 and those for milling $2.92. The Braganza Gold Mining Company, owning the Henrietta claims and a cyanide mill, leased its property to parties who shipped part of the old dump of tailings to the Humboldt smelter. The tailings contained a large percentage of silica, which was valuable as converter lining, and also contained small quantities of copper, gold, and silver. The Ideal Mining and Development Company has sunk its main incline shaft on the Gladstone property at McCabe to a depth of 1,000 feet. This company operated its 80-ton concentrating mill until the close of the Humboldt smelter in September. During 1907 it shipped an important tonnage of crude ore and concentrates containing a total of 361,257 pounds of copper, 12,004.5 ounces of gold, and 117,582 ounces of silver, with a total value of $397,212.[a] The Great Belcher mine was productive of a small shipment of ore containing copper, gold, and silver. The American Copper and Gold Company, owning the Iron King mine, operated until the shutting down of the Humboldt smelter, shipping an important tonnage of copper ore, with gold and silver, used for converter lining. The ore contained 3,933 pounds of copper, 1,253 ounces of gold, and 35,491 ounces of silver.[a] The Jessie Mines Company retimbered to a depth of 340 feet its main shaft, which was damaged by extensive caving. A small lot of ore was shipped. The company expects to treat all future production in a 50-ton milling plant, for which plans and specifications have been furnished. The Poland Mining Company produced from its concentrating plant iron, lead, and zinc concentrates, which contained gold and silver. The iron concentrates of galena and pyrite were sold to the Humboldt and Needles smelters, and those containing zinc to a Colorado plant. The percentage of gold contained in the concentrates was equal to that saved on the amalgamation plates, while the larger part of the silver produced is contained in the concentrates. The crosscut tunnel, 8,071 feet long, connects the terminus of a branch of the Santa Fe Railway at Poland on Big Bug Creek with Walker on Lynx Creek. This tunnel crosscuts the veins of the property, which are worked by raises and winzes from the tunnel level. The total output of lead, zinc, gold, and silver, valued at $130,465, contained 4,217 ounces of gold and 16,609 ounces of silver.[a] The Lelan Gold and Copper Company at Chaparal operated its 10-stamp mill on a test lot of ore containing gold and silver. The property has a vertical shaft 500 feet deep and several drifts and winzes. The Kit Carson claim, at McCabe, was productive of gold and silver ore, containing a small percentage of lead and copper, taken from surface workings. The Spar Mining Company, with property located near Mayer, made a number of shipments of iron sulphide ore, containing lead, copper, gold, and silver, valued at $9,525.[a]

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Black Canyon district.—The Richinbar Mines Company, operating the Gold Note group, is developed by a shaft 530 feet deep. The total development work will aggregate 8,000 feet. The 20-stamp mill equipped for amalgamation and concentration operated part of the year, and some bullion was shipped and the concentrates were held at the property. Other properties producing in the district were the Parker, the Yankee Girl, and the Duquesne groups.

Black Hills district.—The most important property from which ore was shipped in the district was that of the Yaeger Canyon Copper Company, operating the Queen B group. Some of the ore was shipped direct to the smelter and an equal tonnage was put through the company's concentrating mill. The concentrates and crude ore contained copper and silver. The value of the output was $31,719 for 145,849 pounds of copper and 3,893 ounces of silver.[a] Other properties producing were those of the Mingus Mountain Copper Company, the Black Mountain Copper Company, and the Hackberry Mining, Milling and Development Company, which operated the Victoria group.

Black Rock district.—The most important producer in the district was the Interior Mining and Trust Company. The new milling plant was started and the shipments of bullion commenced in August, and of concentrates in September. The ore contains gold and silver. The concentrate averages, per ton, 2 ounces of gold, 3 ounces of silver, 49 per cent of iron, 15 per cent of silica, and 15 per cent of sulphur. The value of the output of 1907 was $33,402.[a] On the Electro group, owned by the Unida Gold Mining Company, an important deposit of copper ore, containing gold, was opened up, and from it 53 tons of ore were shipped, the average content of which was 1.27 ounces of gold and 7.76 per cent of copper per ton. Several shafts have been sunk on the group from 75 to 350 feet in depth. The Yavapai Silver Mines Company, operating the Monte Cristo claims, 12 miles northeast of Wickenburg, made one test shipment of high-grade silver ore. The shaft is 175 feet deep, and several years ago the original owner made small shipments, taken at a depth of 60 feet from a pay streak from 1 to 4 inches wide, rich in native silver and assaying as high as 16,000 ounces per ton. Other productions in the district came from the Zella, the College, and the School Boy claims, and from one of the properties of the Black Rock Mining Company (Limited). The latter mined 600 tons of milling ore, from which gold and silver bullion was extracted in the company's mill.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Blue Tank district.—The Denver group of claims was productive of a small test shipment of copper ore.

Cherry Creek district.—Seven properties in this district yielded gold and silver bullion, extracted from ore treated in 2 stamp mills and 1 arrastra, and a concentrate was produced at one of the plants. There are 3 other mills in the district, which are being put in condition for operation. Cherry Creek, on which the mills are situated, has its source at the east end of the Black Hills range and flows northeast about 15 miles, emptying into the Verde River. The ore is entirely a gold-bearing quartz, oxidized and discolored by iron to an average depth of 100 feet from the surface, when sulphide of iron, which contains the gold, makes its appearance, disseminated through the quartz. The quartz veins occur mostly in granite and are generally parallel to the jointing in the rock. Development work in the district had not been carried on much below 150 feet until recently, and it is reported that the ore containing iron pyrite, though of lower gold content per ton than the ore in the workings nearer the surface, will make a concentrate of shipping grade. On the Broom claim an arrastra was operated on ore which provides the owner with gold bullion when needed. From the treatment of 26 tons of ore from surface cuts $1,556 worth of gold and silver were recovered, and 40 tons of the ore are on the dump awaiting treatment. The Statehood group, formerly owned by the Monarch Gold Mining Company, is another producer, and in early years was known as the Mocking Bird, producing, it is reported, many thousands of dollars from its surface ores. A 5-stamp mill on the property was operated during the year. The Golden Idol Mining Company operated a Nissen stamp mill on ore from its property. The Square Deal Mining Company, the Arizona Copper-Gold Mines Company, the Verde River Copper Company (formerly the Pfau Mining Company), the Cactus Mining Company, and the Etta Mining Company are all actively engaged in development work.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Copper Basin district.—The Commercial Mining Company made shipments of copper ore, taken from its property, which is developed by an adit for 400 feet. The total output, valued at $25,124, contained 125,598 pounds of copper, but no gold or silver.[a] The Copper Hill Mining Company owns 14 locations, on which 465 feet of development was performed and from which a test lot of copper ore containing gold and silver was shipped.

Eureka district.—The Nieman group of 7 claims began regular production the latter part of 1907. The Big Stick Mining Company has taken over a number of former producers in this district. The consolidated properties will be equipped with the mill formerly owned by the Sultan Mining Company.

Hassayampa district.—The Mount Union Consolidated Mining Company has a vertical shaft 680 feet deep. Its reduction plant, equipped with Wilfley tables and Huntington mills, turned out a concentrate containing copper, gold, and silver. The shipments were made to the Needles smelter. The development work for the year consisted in sinking the shaft 80 feet deeper, in drifting 609 feet, and in running 80 feet of upraises. The Storm Cloud mine shipped crude ore, containing copper, gold, and silver to the Humboldt smelter. The Alma-Empire Consolidated Gold Mining Company at Groom Creek did mainly development work in getting the property opened after it had been closed down for five years. The shaft is now 400 feet deep, and sinking is being continued to the 600-foot level. The mill, equipped for amalgamation and the electro-cyanide process, has been remodeled. Ore was taken out during development of the Alma and Empire groups of claims, and shipments made during 1907 contained gold and silver. The property is located 6 miles south of Prescott. On the Ideal group an installation was made of 1 steam stamp-amalgamation mill and a concentrator, which were operated a short time. The gold and silver bullion was shipped, but the concentrates will be held until the Humboldt smelter resumes operation. The shaft on the property is 250 feet deep, sunk on an incline of 77 degrees. The Green Mountain group of 12 claims was bonded to parties who took out about 350 tons of ore containing copper, gold, and silver. The ore was shipped to the Humboldt smelter. The Climax Mining Company produced some bullion in the operation of the mill on its property. The Mount Tritle Copper Company made the most important shipments of the district. The company owns the Dunkirk group, consisting of 9 claims, 3 of which are patented. During the year 750 feet of drifting was done. During this development work, the 30-ton concentration mill, equipped with 4 Nissen stamps and concentrating tables, was operated and produced concentrates containing copper and silver. The Independence Mining Company operated a small mill a short time and produced some gold and silver from the treatment of ore by the cyanide process.

Martinez district.—Development was active on a number of properties, but the only producer of the camp was the Congress Consolidated Mines Company (Limited). The production is principally gold and silver bullion, extracted by the cyanide process. A pyritic concentrate is saved from the ore before the treatment with cyanide solution. There are two 40-stamp mills without amalgamation plates. Standard concentrator tables are used in one of them, and in the other are Wilfleys, Frue vanners, and Overstrom tables. The entire discharge from the tables, exclusive of concentrate product, passes to a system of settling vats. In these the coarse sands are settled, the slimes overflowing into pits. The sands are cyanided direct by the ordinary percolation and leaching method. The slimes, after being settled as thoroughly as possible, are drained of the water, sun-dried to a considerable degree, afterwards roasted, and then subjected to cyanide treatment. The total output, valued at $197,147, contained 9,100 ounces of gold and 13,855 ounces of silver.[a]

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Peck district.—The principal producer in the district is the De Soto Mining Company, which shipped crude ore and ore of milling grade to the Humboldt smelter, where it was concentrated and smelted. The ore contained copper with gold and silver. The total output, valued at $237,079, contained 1,016,170 pounds of copper, 933.31 ounces of gold, and 22,216 ounces of silver.[a] The Lincoln Gold Mining Company, equipped with a mill for amalgamation and concentration, shipped gold and silver bullion and pyritic concentrates. Development work during the year has been on the lower levels of the property. The ore shipments consisted of about 275 tons of first-class ore and 50 tons of concentrates. The freight and treatment charges were $14 per ton. The highest grade of ore shipped was valued at $121.25 per ton and the lowest at $65.69. The receipts from the bullion shipped to the mint were about $8,000. The total output, valued at $31,220, contained 2,568 pounds of copper, 835.7 ounces of gold, and 7,342 ounces of silver.[a] The Great Peck Mining Company shipped one lot of rich silver ore found in an old drift, where it was overlooked in the early days. There is a shaft on this property 387 feet deep and an adit driven 800 feet. The Lone Juniper claim was also productive of some ore.

Thumb Butte district.—The Derby claim is equipped with a 5-stamp plate amalgamation mill and 1 concentrator, which has been kept in operation making tests on the ore. A shaft is sunk 185 feet.

Tiger district.—Several shipments were made from the property of the Crown King Mines Company in cleaning up the old concentrating mill. No great amount of development work was carried on during 1907 on the property. The Tiger Gold Mining Company, which is the largest producer in the district at the present time, shipped gold and silver bullion and concentrates. Some copper is contained in the latter. The property is developed by a shaft 400 feet deep and by 8 adit levels, aggregating 5,600 feet in length. A 20-stamp mill, equipped for amalgamation and concentration, was in operation during the entire year. The shaft is sunk to the level of the main adit, so that the greatest depth is 1,200 feet from the apex of the mountain. The total output, valued at $100,870, contained 19,010 pounds of copper, 4,313.19 ounces of gold, and 9,938 ounces of silver.[a] The Oro Belle property, belonging to the Tiger Gold Company, was operated by lessees during the year, and from it were made shipments of ore to the Tiger mill for concentration and amalgamation. Other shippers in the district were the Savoy Mining Company and the owner of the Lane group, who sent a test lot of ore to the smelter.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

Turkey creek disrict.—The producers of this district during 1907 were the Western Queen Mines Company, the Cumberland Mining Company, and the War Eagle claims.

Verde district.—The United Verde Copper Company has driven its drainage and ventilating adit about 2,000 feet. When completed it will be 6,600 feet long to connect with the new 1,000-foot shaft. At the smelter three 550-ton furnaces have been in operation the greater part of the year. The total output, valued at $7,060,126, contained 33,015,457 pounds of copper, 11,733.76 ounces of gold, and 356,038 ounces of silver.[a] The Consolidated King Development Company and the Columbia Copper Company were the only other producers in the district for 1907.

Walker district.—The most important shipments from the district were taken from the Senate, the Pine Mountain, the Pay Streak, and the Zuli claims. The ore contained principally gold and silver, with some copper.

Walnut Grove district.—The Old Spaniard claim, on which there is an incline shaft 135 feet deep, is equipped with a 3½-foot Huntington mill, which was operated on a small test lot of ore resulting in shipments of gold and silver bullion.

Weaver district.—The district located 10 miles southeast from Congress Junction, is noted for its yield of placer gold from Rich Hill, a high mountain spur of granite where numerous gold nuggets of large size were found as early as 1863. Nuggets of ordinary size have been found there at different times since that date and are sold to the local mercantile establishments, which purchase about $8,000 of the gold each year, production depending much upon the season of rainfall. The Octave Gold Mining Company commenced operations during the year and made important shipments of gold and silver bullion and a lead concentrate. There are 5 incline shafts, the deepest of which is 1,950 feet, and also an adit driven 2,000 feet. The 40-stamp mill, equipped for amalgamation, concentration, and the cyanide process, has a capacity of 132 tons of ore in 24 hours. The quartz ore, containing free gold and with particles of galena disseminated through it, is said to average in value $15 per ton. The ore body, having a northeast-southwest trend, with a dip to the northeast of about 30 degrees from the horizontal, is contained in granite and gneiss. The Rincon Mines Company has opened its property by an incline shaft 1,050 feet deep. It is equipped with a 150-ton Elspass mill and 4 Wilfley tables. The total output was valued at $8,562 for gold, silver, and lead.[a] The Mildred Gold Mining Company, operating the Mayflower group, was productive of a small shipment of sulphide ore, containing copper, gold, and silver.

White Picacho district.—This district overlaps Maricopa County, from which there was one shipment of note. In the Yavapai County portion the Worth Mining Company is developing a group of claims on which it has 3 levels driven from the surface, aggregating in length 800 feet, and 2 shafts, 90 feet and 40 feet deep. Three mills, of 2 stamps each, and a Wilfley concentrator table were operated in testing the ore. The Florentine Mining Company produced a small lot of ore containing copper, gold, and silver, that was shipped to the Humboldt smelter.

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[a] Statement of gross product for the year 1907, published by the auditor of the Territory, 1908.

YUMA COUNTY.

The metal output, consisting of gold, silver, copper, and lead, amounted to $336,060, an increase of $22,537 over the output of 1906. The tonnage aggregated 77,180 tons, as compared with 61,775 tons in 1906, and the average value per ton was lowered from $4.84 in 1906 to $4.20 in 1907. The larger part, or 98.8 per cent, of the tonnage was treated at gold and silver mills, chiefly by the cyanide process, and yielded bullion containing 13,462.10 ounces of gold and 5,084 ounces of silver, valued at $281,642, an average of $3.69 per ton. Of crude ore shipped to smelters, 489 tons making up the total, contained 568.78 ounces of gold, 3,776 ounces of silver, 92,214 pounds of copper, and 48,970 pounds of lead, amounting to $35,288 in value, an average value per ton of $72.16. Ore to concentrating mills aggregated 420 tons, yielding 84 tons of concentrates containing 2,550 ounces of silver, and 101,400 pounds of lead, which amounted to $7,057 in value, an average value per ton of $84.01. The total production of metals in 1907 was 14,611.52 ounces of gold, valued at $302,047; 11,516 ounces of silver, valued at $7,601; 92,214 pounds of copper, valued at $18,443; and 150,370 pounds of lead, valued at $7,969. The value and quantity of yield of each metal increased as follows: Of gold, $6,793; of silver, 1,963 ounces, valued at $1,200; of copper, 72,333 pounds in quantity and $14,606 in value. Lead increased 9,470 pounds in quantity, but decreased $62 in value.

Castle Dome district.—A number of shippers are recorded for this district. The principal shipments were made from the Chilson claim, operated by the Dome Exploration Company, which has discontinued its lease. The La Colorado property was operated, and the ores shipped contained principally lead and a small quantity of silver.

Ellsworth district.—This district produced copper ore containing gold and small quantities of silver. The principal operations were performed by the Wendendale Gold Mining Company, the Western Mining and Leasing Company, the Harqua Hala Mining Company, and the Corona Copper Company, while important shipments were also made from the Boone mines. The Bonanza and Golden Eagle mines were operated by the Harqua Hala Company. On the Eagle claim the shaft has reached a depth of 400 feet, and on the Bonanza claim the shaft is 250 feet deep. A 40-stamp mill is equipped for plate amalgamation and was operated part of the year. The 2 groups of claims, all of which are patented, are located about 1 mile apart and are connected by an aerial tramway. Gold and silver bullion comprising the output contained 1,439.69 ounces of gold and 309 ounces of silver, valued at $29,960.[a] The Boone mine, formerly known as the Bullard mine, is 12 miles from Wendendale, the nearest railroad point. The shaft on the property is 240 feet deep.

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[a] Statement of gross product for the year 1907 published by the auditor of the Territory, 1908.

Kofa district.—The principal producer continues to be the King of Arizona Mining and Milling Company, which operated a 200-ton cyanide mill. The mine is opened by a vertical and incline shaft 670 feet deep and an adit 2,600 feet long. The total output, valued at $251,622, contained 12,022.41 ounces of gold and 4,774 ounces of silver.[a] The North Star mines have recently been opened and developed by the Golden Star Mining and Milling Company. During 1907 development work amounted to 400 feet. The working shaft is down to a depth of 80 feet. A shipment of 17½ tons of ore containing gold and silver was sent to the smelter as a test lot, which was estimated in value for the gold and silver at $9,774.[a] The equipment for a milling plant has been delivered at Mohawk, the railroad station of the company.

Plomosa district.—Many small shipments were sent out from this district as test lots when the new railway was extended to Parker on the Colorado River. The ores contained principally lead, and some copper, gold, and silver. The ores shipped thus far are largely from surface croppings, and none of the properties from which shipments were reported has a greater depth than 75 feet.

CALIFORNIA.

By Charles G. Yale.

PRODUCTION.

For the calendar year 1907 the California production of gold, silver, copper, lead, and zinc was valued at $23,338,104, as compared with $25,126,359 in 1906, a decrease in 1907 of $1,788,255. The decrease is due to the smaller yield of gold, which was $2,004,524 less in 1907 than in 1906. The silver yield also decreased, while the values of copper, lead, and zinc increased, with the above mentioned net result. Reports were received from 1,061 producing properties. Of these 443 were deep mines, of which 408 yielded siliceous gold ores, 6 silver, 1 silver and gold, 20 copper, 5 lead, 2 zinc-lead, and 1 copper-lead ores. The output of these mines was 2,054,653 tons of ore, which was a decrease of 501,403 tons from that of 1906. The siliceous ore amounted to 1,704,549 tons, and decreased in quantity 531,366 tons from the output of 1906. Its average value was $5.75 per ton in gold and silver. Copper ores showed a tonnage of 339,152 for 1907, an increase of 20,942 tons. The lead ores amounted to 7,852 tons, which is an increase of 6,171 tons over the output of 1906. Of copper-lead ores there were 40 tons, and of lead-zinc ores 3,060 tons, an increase in the latter of 2,810 tons.

During 1907 there were treated at gold and silver mills 1,654,241 tons of ore containing $9,256,005 in gold, an average of $5.59 per ton, and silver valued at $191,693, an average of 12 cents per ton, a total of $9,447,698 in gold and silver, an average of $5.71 per ton in both metals. Of this total $7,587,601 in gold, averaging $4.59 per ton, and $159,415 in silver, averaging 9 cents per ton, a total of $7,747,016 in gold and silver, averaging $4.68 per ton, was recovered on the amalgamating plates of the mills. From these 1,654,241 tons of ore 32,450 tons of concentrates were recovered, valued at $1,668,404 in gold, averaging $51.41 per ton, and $32,278 in silver, averaging 99 cents per ton, a total of $1,700,682, averaging $52.40 in gold and silver per ton. Of smelting ores there were 375,506 tons, valued at $631,228 in gold, an average value of $1.68 per ton, and $535,351 in silver, an average value of $1.43 per ton, or a total in gold and silver of $1,166,579, and an average per ton of $3.11 in gold and silver. In addition to this there were 24,906 tons of old tailings, slag, etc., worked, the bullion content of which is included in mill bullion.

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[a] Statement of gross product for the year 1907 published by the auditor of the Territory, 1908.

There were 618 productive placers reporting in 1907 in California, of which 193 were hydraulic mines, 57 dredges, 106 drift mines, and 262 surface or slucing mines. These placers yielded $6,840,695 in gold and $24,602 in silver, a total of $6,865,297 in both gold and silver, which is a decrease of $535,230 in gold and of $3,480 in silver, a total decrease of $538,710 from this source in 1907 as compared with 1906.

The statement of production for 1906 and 1907, showing increase or decrease, and value at each year's average commercial prices, is as follows:

Production of gold, silver, and associated metals in California in 1906 and 1907.

	1906.		1907.		Increase(+)decrease(−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	906,182.37	$18,732,452	809,213.52	$16,727,928	96,968.85	−$2,004,524
Silver..................do....	1,220,641	817,830	1,138,858	751,646	− 81,783	− 66,184
Copper ....pounds..	28,726,448	5,544,204	28,528,020	5,705,604	− 198,428	+ 161,400
Lead ....do....	338,718	19,307	2,625,419	139,147	+2,286,701	+ 119,840
Zinc...................do....	206,000	12,566	233,550	13,779	+ 27,550	+ 1,213
Total.................	....	25,126,359	....	23,338,104	....	− 1,788,255

The production of ore in California in 1907 was 2,054,653 tons, valued at $16,472,807, an average of $8.02 per ton, as compared with 2,556,056 tons in 1906, valued at $16,700,860, an average of $6.53 per ton. This is a decrease in quantity in 1907 of 501,403 tons, and an increase of $1.49 in average value per ton. The placer yield is, of course, not considered in this statement, though the totals include the values of the quartz gold and silver and values of all copper, lead, and zinc produced in 1907.

GOLD.

The total gold production of the State amounted to 809,213.52 fine ounces, valued at $16,727,928, in 1907, as against 906,182.37 ounces, valued at $18,732,452, in 1906, a decrease of 96,968.85 ounces in quantity and of $2,004,524 in value. Of the total value $6,840,695 came from placers of various kinds—hydraulic, dredge, drift, and surface mines—and the deep mines yielded $9,887,233. Out of the 1,061 producing mines in the State, 1,046 made some gold yield in 1907, leaving only 15 mines from which no gold was derived. Gold was obtained in 33 counties of the State, but only 10 of those showed an increase in 1907 over 1906, the other counties showing a decrease. The largest production of gold ($2,786,840) came from Butte County, and was mainly derived from dredging operations, this county leading all others in the production of placer gold. The largest output of deep-mine siliceous ore gold came from Amador County—$2,100,349—Amador thus for the first time exceeding Nevada County in this respect. The largest output of gold from hydraulic mining operations was from Trinity County, $335,322; from drift mines, from Placer County, $216,240; from dredges, from Butte County, $2,697,092, and from surface placers or sluicing mines, from Yuba County, $52,782. The county which shows the largest increased gold output for the year is Yuba, where it amounts to $494,952, and the greatest decrease is shown in Calaveras County. The counties of the State which produced more gold in 1907 than in 1906 showed a combined increase of gold product valued at $766,347 and those producing less gold showed a combined decrease of $2,770,871, the net decrease for the State being $2,004,524. The reasons for these changes in output are given in other portions of this chapter under the records of individual counties. The production of gold from placers and from different kinds of ore in California in 1907, by counties, in fine ounces, is given in the following table:

Source of gold production in California by kinds of ore in 1907, by counties, in fine ounces.

County.	Placers.		Deep mines.			
			Siliceous ore.		Copper ores.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Amador	765.92	$15,833	101,604.39	$2,100,349	....	....
Butte	134,759.60	2,785,728	53.79	1.112	....	....
Calaveras	5,413.45	111,906	45,078.29	931,851	2,622.75	$54,217
Colusa	....	....	35.51	734	....	....
Del Norte	42.47	878	....	....	....	....
Eldorado	2,106.49	43,545	13,333.70	275,632	....	....
Fresno	9.97	206	106.18	2,195	....	....
Humboldt	1,940.22	40,108	....	....	.05	1
Inyo	....	....	2,308.75	47,726	.53	11
Kern	44.12	912	42,467.73	877,886	....	....
Los Angeles, Orange, and Ventura	....	....	516.50	10,677	....	....
Madera	62.50	1,292	581.03	12,011	....	....
Mariposa	43.97	909	19,570.78	404,564	1.21	.25
Merced	39.76	822	....	....	....	....
Mono	....	....	18,574.60	383,971	....	....
Monterey	12.09	250	39.96	826	....	....
Nevada	6,376.16	131,807	98,214.60	2,030,276	....	....
Placer	16,666.69	344,531	6,687.41	138,241	....	....
Plumas	6,214.49	128,465	4,396.80	90,890	....	....
Riverside	29.17	603	156.40	3,233	....	....
Sacramento	38,263.32	790,973	....	....	....	....
San Bernardino	41.36	855	6,805.78	140,688	828.81	17,133
San Diego	48.38	1,000	312.26	6,455	....	....
San Luis Obispo	15.29	316	....	....	....	....
Shasta	1,118.91	23,130	23,985.92	495,833	13,208.02	273,034
Sierra	4,561.91	94,303	18,846.95	389,601	....	....
Siskiyou	10,497.52	217,003	8,756.55	181,014	....	....
Stanislaus	27.52	569	135.21	2,795	....	....
Trinity	17,182.61	355,196	8,713.31	180,120	....	....
Tuolumne	124.95	2,583	38,907.67	804,293	....	....
Yuba	84,509.75	1,746,972	957.73	19,798	....	....
Total	330,918.62	6,840,695	461,147.80	9,532,771	16,661.37	344,421

Source of gold production in California, etc.—Continued.

County.	Deep mines.						Grand total.	
	Lead ores.		Lead-zinc ores.		Total.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Amador					101,604.39	$2,100,349	102,370.31	$2,116,182
Butte					53.79	1,112	134,813.39	2,786,840
Calaveras					47,701.04	986.068	53,114.49	1,097,974
Colusa					35.51	734	35.51	734
Del Norte							42.47	878
Eldorado					13,333.70	275,632	15,440.19	319,177
Fresno					106.18	2,195	116.15	2,401
Humboldt					.05	1	1,940.27	40,109
Inyo	459.75	$9,504			2,769.03	57,241	2,769.03	57,241
Kern					42,467.73	877,886	42,511.85	878,798
Los Angeles, Orange, and Ventura			25.98	$537	542.48	11,214	542.48	11,214
Madera					581.03	12,011	643.53	13,303
Mariposa					19,571.99	404,589	19,615.96	405,498
Merced							39.76	822
Mono					18,574.60	383,971	18,574.60	383,971
Monterey					39.96	826	52.05	1,076
Nevada					98,214.60	2,030,276	104,590.76	2,162,083
Placer					6,687.41	138,241	23,354.10	482,772
Plumas					4,396.80	90,890	10,611.29	219,355
Riverside					156.40	3,233	185.57	3,836
Sacramento							38,263.32	790,973
San Bernardino					7,634.59	157,821	7,675.95	158,676
San Diego					312.26	6,455	360.64	7,455
San Luis Obispo							15.29	316
Shasta					37,193.94	768,867	38,312.85	791,997
Sierra					18,846.95	389,601	23,408.86	483,904
Siskiyou					8,756.55	181,014	19,254.07	398,017
Stanislaus					135.21	2,795	162.73	3,364
Trinity					8,713.31	180,120	25,895.91	535,316
Tuolumne					38,907.67	804,293	39,032.63	806,876
Yuba					957.73	19,798	85,467.51	1,766,770
Total	459.75	9,504	25.98	537	478,294.90	9,887,233	809,213.52	16,727,928

Comparison of these totals for 1907 with the gold output of 1906 is as follows:

Production of gold in California in 1906 and 1907, by kinds of ore, in fine ounces.

Year.	Placers.		Deep mines.			
			Siliceous ore.		Copper ores.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1906	356,810.37	$7,375,925	533,867.37	$11,036,018	15,406.91	$318,489
1907	330,918.62	6,840,695	461,147.80	9,532,771	16,661.37	344,421
Increase (+) or decrease (−)	−25,891.75	−535,230	−72,719.57	−1,503,247	+1,254.46	+25,932

Year.	Deep mines.						Grand total.	
	Lead ores.		Lead-zinc ores.		Total.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1906	49.34	$1,020	48.38	$1,000	549,372.00	$11,356,527	906,182.37	$18,732,452
1907	459.75	9,504	25.98	537	478,294.90	9,887,233	809,213.52	16,727,928
Increase (+) or decrease (−).	+410.41	+8,484	−22.40	−463	−71,077.10	−1,469,294	−96,968.85	−2,004,524

The source of placer gold by counties and from various kinds of mines is shown as follows:

Source of placer gold in California in 1906, by counties.

County.	Hydraulic.	Drift.	Dredging.	Surface placers.	Total.
Amador	$3,830	$3,387		$8,616	$15,833
Butte	18,375	22,158	$2,697,092	48,103	2,785,728
Calaveras	5,000	63,712		28,392	97,104
Del Norte	142			736	878
Eldorado	8,190	20,666		14,689	43,545
Fresno				206	206
Humboldt	37,473			2,635	40,108
Kern				912	912
Madera				1,292	1,292
Mariposa				909	909
Merced				822	822
Monterey				250	250
Nevada	77,362	45,852		8,593	131,807
Placer	89,428	216,240		38,863	344,531
Plumas	103,342	5,005		20,118	128,465
Riverside				603	603
Sacramento		127,075	649,511	14,387	790,973
San Bernardino				855	855
San Diego				1,000	1,000
San Luis Obispo				316	316
Shasta				7,130	7,130
Sierra	42,749	48,551		3,003	94,303
Siskiyou	181,458	6,969		28,576	217,003
Stanislaus				569	569
Trinity	335,322	1,650		18,224	355,196
Tuolumne	1,100	1,200		283	2,583
Yuba	5,240	918	1,688,032	52,782	1,746,972
Calaveras and Shasta dredges			30,802		30,802
Total	909,011	563,383	5,065,437	302,864	6,840,695
Decrease	145,161	42,434	32,922	314,713	535,230

The following table shows the increase or decrease of California gold in 1907, by counties.

Increase and decrease in gold production in 1907, by counties.

County.	Increase.	Decrease.	County.	Increase.	Decrease.
Amador		$144,194	Placer		$91,134
Butte		229,907	Plumas		9,995
Calaveras		546,260	Riverside		596
Colusa	$734		Sacramento		195 651
Del Norte		5,067	San Bernardino		196,154
Eldorado		112,569	San Diego and San Luis Obispo		9,609
Fresno		6,092	Santa Barbara		250
Humboldt		8,186	Shasta		27,147
Inyo	37,792		Sierra	$74,538	
Kern	72,681		Siskiyou and Stanislaus		336,959
Lassen, Los Angeles, Orange, and Ventura		87,312	Trinity		25,527
Madera		9,087	Tulare		20
Mariposa	39,104		Tuolumne		232,799
Mendocino		19	Yuba	494,952	
Merced	822		Total	766,347	2,770,871
Mono	45,273		Decrease		2,004,524
Monterey	451				
Nevada		496,337			

SILVER.

The silver yield in 1907 amounted to 1,138,858 fine ounces, valued at $751,646, as against 1,220,641 ounces in 1906, valued at $817,830, a decrease of 81,783 ounces in quantity and of $66,184 in value. The larger proportion—valued at $401,099—came from the smelting of copper ores, the siliceous ore yielding silver valued at $271,196. The most productive county in silver was Shasta, where the largest copper smelters are, the Shasta yield being valued at $370,211 for the year. From lead ores Inyo County made the largest yield, valued at $43,992; from siliceous ore the mines of Kern County made the highest silver yield, valued at $86,023. The following table shows the source of silver production in California in 1907 by kinds of ore and in fine ounces:

Source of silver product in California by kinds of ore, in 1907, by counties, in fine ounces.

County.	Placers.		Deep mines.					
			Siliceous ore.		Copper ores.		Lead ores.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Amador	74	$49	20,403	$13,466	....	....	....	....
Butte	13,582	8,964	5	3	....	....	....	....
Calaveras	730	482	6,817	4,499	74,907	$49,439	....	....
Colusa	....	....	12	8	....	....	....	....
Del Norte	4	3	....	....	....	....	....	....
Eldorado	592	391	2,894	1,910	....	....	....	....
Fresno	....	....	39	26	....	....	....	....
Humboldt	323	213	....	....	2	1	....	....
Inyo	....	....	570	376	17	11	66,654	$43,992
Kern	15	10	130,338	86,023	....	....	....	....
Los Angeles, Orange, and Ventura	....	....	1,197	790	....	....	....	....
Madera	9	6	270	178	488	322	....	....
Mariposa	5	3	6,283	4,147	....	....	....	....
Merced	15	10	....	....	....	....	....	....
Mono	....	....	45,147	29,797	....	....	....	....
Monterey	3	2	11	7	....	....	....	....
Nevada	1,136	750	25,386	16,755	....	....	....	....
Placer	2,300	1,518	2,788	1,840	....	....	....	....
Plumas	938	619	498	329	....	....	....	....
Riverside	5	3	35	23	....	....	....	....
Sacramento	3,082	2,034	....	....	....	....	....	....
San Bernardino	6	4	108,577	71,661	14,021	9,254	37	24
San Diego	8	5	45	30	....	....	....	....
Shasta	170	112	42,465	28,027	518,291	342,072	....	....
Sierra	568	375	3,403	2,246	....	....	....	....
Siskiyou	2,064	1,362	2,538	1,675	....	....	....	....
Stanislaus	10	7	32	21	....	....	....	....
Trinity	2,364	1,560	1,271	839	....	....	....	....
Tuolumne	20	13	9,758	6,440	....	....	....	....
Yuba	9,253	6,107	121	80	....	....	....	....
Total	37,276	24,602	410,903	271,196	607,726	401,099	66,691	44,016

Source of silver product in California by kinds of ore, etc.—Continued.

County.	Deep mines.						Grand total.	
	Copper-lead ores.		Lead-zinc ores.		Total.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Amador					20,403	$13,466	20,477	$13,515
Butte					5	3	13,587	8,967
Calaveras					81,724	53,938	82,454	54,420
Colusa					12	8	12	8
Del Norte							4	3
Eldorado					2,894	1,910	3,486	2,301
Fresno					39	26	39	26
Humboldt					2	1	325	214
Inyo			92	$61	67,333	44,440	67,333	44,440
Kern					130,338	86,023	130,353	86,033
Los Angeles, Orange, and Ventura			15,570	10,276	16,767	11,066	16,767	11,066
Madera					758	500	767	506
Mariposa					6,283	4,147	6,288	4,150
Merced							15	10
Mono					45,147	29,797	45,147	29,797
Monterey					11	7	14	9
Nevada					25,386	16,755	26,522	17,505
Placer					2,788	1,840	5,088	3,358
Plumas					498	329	1,436	948
Riverside					35	23	40	26
Sacramento							3,082	2,034
San Bernardino	600	$396			123,235	81,335	123,241	81,339
San Diego					45	30	53	35
Shasta					560,756	370,099	560,926	370,211
Sierra					3,403	2,246	3,971	2,621
Siskiyou					2,538	1,675	4,602	3,037
Stanislaus					32	21	42	28
Trinity					1,271	839	3,635	2,399
Tuolumne					9,758	6,440	9,778	6,453
Yuba					121	80	9,374	6,187
Total	600	396	15,662	10,337	1,101,582	727,044	1,138,858	751,646

Comparisons of these totals for 1907 with the silver output in 1906 are as follows:

Production of silver in California in 1906 and 1907, by kinds of ore, in fine ounces.

Year.	Placers.		Deep mines.					
			Siliceous ore.		Copper ores.		Lead ores.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1906	41,913	$28,082	376,345	$252,151	756,276	$506,705	16,107	$10,792
1907	37,276	24,602	410,903	271,196	607,726	401,099	66,691	44,016
Increase (+) or decrease (−)	−4,637	−3,480	+34,558	+19,045	−148,550	−105,606	+50,584	+33,224

Year.	Deep mines.						Grand total.	
	Copper-lead ores.		Zinc-lead ores.		Total.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1906			30,000	$20,100	1,178,728	$789,748	1,220,641	$817,830
1907	600	$396	15,662	10,337	1,101,582	727,044	1,138,858	751,646
Increase (+) or decrease (−)	+600	+396	−14,338	−9,763	−77,146	−62,704	−81,783	−66,184

COPPER.

The yield of copper in California in 1907 as shown by returns from producers was 28,528,020 pounds, valued at $5,705,604, as compared with 28,726,448 pounds in 1906, valued at $5,544,204, a decrease in quantity of 198,428 pounds, but an increase in value of $161,400. Copper was produced in 10 counties of the State in 1907, the heaviest production coming, as usual, from Shasta County, which alone yielded 23,457,417 pounds, valued at $4,691,483. The increase for this county as compared with the production of 1906 was 980,113 pounds in quantity and $353,362 in value. Calaveras County, next in importance as a copper-producing section, showed a falling off in output, while in San Bernardino County there was a very slight change in totals in the two years. Inyo County showed an increase, and Nevada County had a small output in 1907, none having been reported in 1906. There were altogether 339,152 tons of copper ore treated in 1907, an increase of 20,942 tons over the quantity treated in 1906. In addition to their copper content, these ores yielded an average value per ton of $2.20 in gold and silver. The largest single output of copper by any one mine or company was from the Mammoth Copper Mining Company at Kennett, Shasta County. The smelter of the Balaklala Copper Mining Company, in the same county, was completed in 1908.

LEAD.

The quantity of lead produced in California in 1907 was 2,625,419 pounds, valued at $139,147, as compared with 338,718 pounds, valued at $19,307, in 1906. The increase in quantity for 1907 is therefore 2,286,701 pounds, and in value $119,840. By far the larger proportion of this lead was derived from Inyo County, where are the properties of the Tecopa Mining Company, now the largest lead producer in the State. The mines at that point made no product in 1906, and their yield for 1907 accounts for the very material increase in that year.

ZINC.

The production of zinc in California in 1907 was 233,550 pounds, valued at $13,799, as compared with 206,000 pounds, valued at $12,566, in 1906—an increase of 27,550 pounds in quantity and of $1,213 in value. All the zinc produced came from Inyo County.

PROGRESS OF THE MINING INDUSTRY IN CALIFORNIA IN 1907.

Considering the values of all metals—gold, silver, copper, lead, and zinc—California shows a reduced output in 1907 of $1,788,255, as compared with the total of 1906. The most material loss is in gold, but the silver output was less also, while increased yield in values was shown in copper, lead, and zinc.

The reduction in value of gold output of over $2,000,000 is naturally the most serious matter for consideration, as this metal has always been California's most important mining output. Yet, with the exception of 15 mines, all the 1,061 mines in the State reporting production yielded more or less gold. The falling off has been quite general, the larger proportion of counties showing decreased returns, some of them to quite a marked degree. This is notably the case in the counties of Amador, Butte, Calaveras, Eldorado, Nevada, San Bernardino, Sacramento, Siskiyou, and Tuolumne. Of the Mother

Lode counties of the State, only 1, Mariposa, showed an increase of gold output for the year, and the combined gold output of these 5 counties, Eldorado, Amador, Calaveras, Tuolumne, and Mariposa, showed a reduction of value in 1907, as compared with 1906, of $996,718. The reduction in these counties is most marked in Calaveras, where it was due to miners' strikes, which closed the principal quartz producers for several months. The tonnage of siliceous ores in California, from which most of the deep-mine gold is derived, was reduced nearly one-fourth, or by 531,366 tons. From these siliceous ores in 1907 the gold yield was 461,147.80 fine ounces, valued at $9,532,771, while it was 533,867.37 ounces, valued at $11,036,018, in 1906. This is a decrease of 72,719.57 ounces in quantity and of $1,503,247 in value. For the last few years the statistics show a gradual falling off of tonnage of siliceous ores in California, and a resultant decrease in gold output, which the placer gold yield was not able to offset even while increasing in itself, and the output from this source was less in 1907 than it was in 1906. The reduction in gold yield of the placers was general and from all classes of mines. On comparison of the figures for 1907 and 1906, the hydraulic mines showed a reduced yield for 1907 of $145,161; the drift mines a loss of $42,434; the dredgers a loss of $32,922; and the surface placers a loss of $314,713—the total reduction from this source being placed at $535.230. The most surprising feature of this is the decrease in output for the year of the dredging interests. In 1906 the dredges increased the value of their gold yield over that of 1905 by $1,822,216, yet in 1907 the decrease from 1906 amounted to $32,922; and this, too, with several new dredges put into operation in 1907, though they began work rather late in the year. The floods at Oroville in the spring of 1907 wrecked several dredges and put some others under repair for a time. Moreover, at this point, as well as in the Folsom field, notably at the latter place, there was much complaint of irregular supply of power. Indeed, some of the dredge owners maintain that they lost nearly 25 per cent of the working time from this cause. The decreased output may be further explained by the fact that when dredges are first installed on the ground purchased they are naturally started on what is supposed to be the best portion of it. Some of the older companies are, therefore, now working the poorer ground in their dredging tracts. The situation as to power will doubtless be remedied as soon as possible by the power companies increasing their capacity, steps for which are now being taken. Moreover, the new dredges recently built, and those under construction, are of greatly increased strength and capacity over those of earlier type, and can dig deeper and pile higher while operating at a much lower cost per cubic yard. Indeed, one of the latest installations in the Folsom field, having buckets of a capacity of 13 cubic feet each, handled in July, 1908, the enormous quantity of 257,029 cubic yards, at an operating cost of 1.93 cents per cubic yard. This is in so-called light ground, which averages from 23 to 30 feet in depth, but in some places is 43 feet. This ground runs as low in value as 6 cents per cubic yard and as high as 17 cents, the general average being from 12 to 15 cents. Another dredge in the same field, with buckets of a capacity of 8½ cubic feet, dug in July, 1908, 116,134 cubic yards at a cost of 3.38 cents per cubic yard.

This was in hard ground, the dredge digging 48 feet below the water level in which the boat floats and piling the cobbles, etc., 25 feet above the basin. A new feature in the dredging industry is the use of hydraulic nozzles in mining certain banks. At places in the Folsom field the ground is almost cemented, and streams of water under pressure are used to loosen the ground above the basin; sometimes it is necessary to resort to a little blasting as well. The other dredging fields of the State showed a reduction in yield for the year, but the Yuba field, near Marysville, had an output valued at nearly $500,000 more than that of 1906. There are 12 dredges in that field, nearly all large new ones, and more are being built. The field is supposed to be the most extensive in the State. In 1907 there were altogether 57 dredges operating in California and having a combined gold yield valued at $5,065,437. The placer gold table in the report of 1906 gave the number of dredging companies in each county, and some of these had several dredges. The table used this year gives the number of dredges, irrespective of ownership, and this course will be followed in the future in these reports, so that suitable comparisons may be made between the outputs of the respective years. The largest number of dredges in the State was in the Oroville field, where 35 were in operation during 1907. In the Sacramento or Folsom field there were 7. Several new ones are being added in these fields, as well as at different localities in other counties. One was put in operation in Merced County in 1908, the first in that region. Hydraulic mining in California is at its best in the counties of Trinity and Siskiyou, where there are no restrictions as to care of the débris, as is the case in the counties in the drainage basins of the Sacramento and the San Joaquin rivers. In these latter counties this industry continues on the decline. Placer and Sacramento counties are the only localities where any notable drift mining is carried on at present, though some work of this kind is done in Amador, Butte, Calaveras, Eldorado, Nevada, Plumas, Sierra, Siskiyou, Trinity, and Yuba counties. Surface placers or sluicing mines are worked in all the gold-producing counties of the State, but this interest is gradually on the decline, as the area of available ground becomes less each year.

There are now few mines in California worked for silver alone. This metal is obtained mainly from the placers with the gold and from the siliceous, copper, and lead ores. The total yield for the year shows a slight decrease, as compared with that of 1906.

The copper industry of the State is gradually increasing in importance in value of yearly output, but it can not be said that there is any widening of the mining field. Copper was produced in 10 counties of the State in 1907, as compared with 7 counties in 1906, but the new counties made only small outputs. When the Western Pacific Railroad, now under construction, is completed, the Plumas County copper field, now being prospected, will probably become productive. New railroads between Los Angeles, in the southern portion of California, and Nevada and Utah will doubtless have an effect in developing known copper deposits in that region by furnishing transportation. The agitation in the counties around San Francisco Bay with relation to alleged damage by smelter fumes is affecting custom smelters, and, indeed, in August, 1908, the Selby smelter was closed by injunction, pending investigation as to certain effects of the fumes on vegetation and into new methods adopted by the smelting company for preventing the escape of these fumes. During the shut down of the smelter the California ores formerly going to it were sent to smelters at Salt Lake City. This same agitation stopped work on the proposed copper smelter at Baden on San Francisco Bay, where some hundreds of thousands of dollars had already been spent. What were virtually prohibitory ordinances, adopted by county supervisors, caused the stoppage of work entirely for the present. The owners of the smelter hope to prove to the satisfaction of the public that the plants may be operated without material damage to the surrounding country.

Lead and zinc mining are not carried on to any very great extent in this State, these metals being mined in only 4 counties, and almost the entire output of both metals being derived from Inyo County. The lead-mining industry is, however, increasing in importance.

Prospecting was carried on vigorously in San Bernardino and Inyo counties, especially along the new Tonopah and Tidewater Railroad, extending southward from Rhyolite, Nev., to the Santa Fe Railroad. Several new camps were discovered.

As the Mother Lode counties of California are noted widely for the great width, productiveness, and continuity in both length and depth of their gold-producing veins, it may be proper at this place to give the results of the mining operations along the lode, in both the main and the east belt, for the year 1907. In this connection it may be stated, also, that the great new 3-compartment shaft of the Kennedy Mining and Milling Company at Jackson, Amador County, on the main Mother Lode, has attained a vertical depth of 3,254 feet (August, 1908), and that the ore at that depth carries values as high as in other productive portions of the mine. The record for the Mother Lode counties of the State in 1907 is shown in the following table:

Tonnage of ore and value recovered in bullion in gold and silver mills, tonnage and value of concentrates produced, and total recovery with average values per ton, in Mother Lode counties, California, in 1907.

County.	Ore to gold and silver mills.				Concentrates produced.				Total recovery.	Total average recovery per ton.
	Quantity.	Gold in bullion.	Silver in bullion.	Average value in gold and silver recovered on plates.	Quantity.	Gold.	Silver.	Average value in gold and silver.		
	Short tons.				*Short tons.*					
Amador........	444,341	$1,342,377	$9,774	$3.04	11,296	$757,972	$3,692	$67.43	$2,113,815	$4.76
Calaveras.....	251,613	715,264	3,890	2.86	4,190	216,587	609	51.84	936,350	3.72
Eldorado......	33,781	248,370	1,651	7.40	576	27,262	259	47.78	277,542	8.22
Mariposa......	51,076	348,559	3,325	6.89	643	56,005	822	88.38	408,711	8.00
Tuolumne	194,209	636,309	4,955	3.30	6,598	167,984	1,485	25.68	810,733	4.17
Total....	975,020	3,290,879	23,595	3.40	23,303	1,225,810	6,867	52.90	4,547,151	4.66

Under the heading, "Production by individual counties," in this chapter, will be found a statement of the conditions in the respective counties of California and the reasons for the increase or decrease in production for the year 1907, as compared with that of 1906.

The following table shows the production of gold, silver, and associated metals in California, by counties:

Production of gold, silver, and associated metals in California in 1907, by counties.

County.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
Amador	102,370.31	$2,116,182	20,477	$13,515
Butte	134,813.39	2,786,840	13,587	8,967
Calaveras	53,114.49	1,097,974	82,454	54,420
Colusa	35.51	734	12	8
Del Norte	42.47	878	4	3
Eldorado	15,440.19	319,177	3,486	2,301
Fresno	116.15	2,401	39	26
Humboldt	1,940.27	40,109	325	214
Inyo	2,769.03	57,241	67,333	44,440
Kern	42,511.85	878,798	130,353	86,033
Los Angeles, Orange, and Ventura	542.48	11,214	16,767	11,066
Madera	643.53	13,303	767	506
Mariposa	19,615.96	405,498	6,288	4,150
Merced	39.76	822	15	10
Mono	18,574.60	383,971	45,147	29,797
Monterey	52.05	1,076	14	9
Nevada	104,590.76	2,162,083	26,522	17,505
Placer	23,354.10	482,772	5,088	3,358
Plumas	10,611.29	219,355	1,436	948
Riverside	185.57	3,836	40	26
Sacramento	38,263.32	790,973	3,082	2,034
San Bernardino	7,675.95	158,676	123,241	81,339
San Diego	360.64	7,455	53	35
San Luis Obispo	15.29	316		
Shasta	38,312.85	791,997	560,926	370,211
Sierra	23,408.86	483,904	3,971	2,621
Siskiyou	19,254.07	398,017	4,602	3,037
Stanislaus	162.73	3,364	42	28
Trinity	25,895.91	535,316	3,635	2,399
Tuolumne	39,032.63	806,876	9,778	6,453
Yuba	85,467.51	1,766,770	9,374	6,187
Total	809,213.52	16,727,928	1,138,858	751,646

County.	Copper.		Lead.		Zinc.		Grand total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Amador	5,300	$1,060					$2,130,757
Butte							2,795,807
Calaveras	4,386,243	877,249					2,029,643
Colusa							742
Del Norte							881
Eldorado							321,478
Fresno							2,427
Humboldt	980	196					40,519
Inyo	15,587	3,117	2,596,399	$137,609	233,550	$13,779	256,186
Kern							964,831
Los Angeles, Orange, and Ventura			14,000	742			23,022
Madera	23,964	4,793					18,602
Mariposa	7,984	1,597					411,245
Merced							832
Mono							413,768
Monterey							1,085
Nevada	22,111	4,422					2,184,010
Placer	17,785	3,557					489,687
Plumas							220,303
Riverside							3,862
Sacramento							793,007
San Bernardino	590,649	118,130	9,020	478			358,623
San Diego							7,490
San Luis Obispo							316
Shasta	23,457,417	4,691,483					5,853,691
Sierra							486,525
Siskiyou							401,054
Stanislaus							3,392
Trinity							537,715
Tuolumne			6,000	318			813,647
Yuba							1,772,957
Total	28,528,020	5,705,604	2,625,419	139,147	233,550	13,779	23,338,104

The total tonnage, by kinds of ore treated or sold in each county of California in 1907, is shown in the following table:

Subdivision of tonnage of crude ore sold or treated in California in 1907, by counties, in short tons.

County.	Siliceous ore.	Copper ores.	Lead ores.	Copper-lead ores.	Zinc-lead ores.	Total ore.
Amador	444,341					444,341
Butte						
Calaveras	251,613	43,828				295.441
Colusa						
Del Norte						
Eldorado	33,781					33,781
Fresno	112					112
Humboldt		2				2
Inyo	6,995	39	7,850		2,800	17,684
Kern	236,853					236,853
Los Angeles, Orange, and Ventura	3,080				260	3,340
Madera	1,056	734				1,790
Mariposa	51,076	63				51,139
Merced						
Mono	32,363					32,363
Monterey	41					41
Nevada	227,288	329				227,617
Placer	20,317					20,317
Plumas	23,907					23,907
Riverside	178					178
San Bernardino	20,537	5,579	2	40		26,158
San Diego	374					374
Shasta	54,278	288,578				342,856
Sierra	56,625					56,625
Siskiyou	15,390					15,390
Stanislaus	380					380
Trinity	25,148					25,148
Tuolumne	194,209					194,209
Yuba	4,607					4,607
Total	1,704,549	339,152	7,852	40	3,060	2,054,653
Increase (+) or decrease (−)	− 531,366	+ 20,942	+6,171	+40	+2,810	− 501,403
Average value per ton in gold and silver	$5.75	$2.20	$6.83	[a] $9.90	$3.55	$5.17

[a] Silver alone.

As shown by the following table, reports were received from 3,062 mines in California in 1907, of which 1,061 were productive, and the others either idle, held by assessment, or under development only:

Number of mines in California, classified by chief product, in 1907, by counties.

County.	Nonproducing mines.	Gold placer mines.					Deep mines.								Total mines reporting product.
		Hydraulic.	Dredging.	Drift.	Surface.	Total.	Gold.	Silver.	Gold and silver.	Copper.	Lead.	Zinc-lead.	Copper-lead.	Total.	
Alpine	6														
Amador	63	3		4	6	13	22			1				23	36
Butte	91	3	35	9	22	69	3							3	72
Calaveras	156	1	1	7	20	29	45			3				48	77
Colusa							1							1	1
Del Norte	8	2			4	6									6
Eldorado	128	5		10	16	31	30							30	61
Fresno	14				2	2	4							4	6
Humboldt	11	18			4	22				1				1	23
Inyo	92						11			1	4	1		17	17
Kern	97				3	3	37							37	40
Lassen	9														
Los Angeles, Orange, and Ventura	18						4					1		5	5
Madera	33				2	2	8			1				9	11
Mariposa	78				2	2	20			2				22	24

Number of mines in California, classified by chief product, etc.—Continued.

County.	Nonproducing mines.	Gold placer mines.					Deep mines.								Total mines reporting product.
		Hydraulic.	Dredging.	Drift.	Surface.	Total.	Gold.	Silver.	Gold and silver.	Copper.	Lead.	Zinc-lead.	Copper-lead.	Total.	
Mendocino	2	....	....	....	....	....	....	....	......	....	....	....	....	....	......
Merced	......	....	....	....	2	2	....	....	......	....	....	....	....	....	2
Modoc	5	....	....	....	....	....	....	....	......	....	....	....	....	....	......
Mono	48	....	....	....	....	....	8	....	......	....	....	....	....	8	8
Monterey	5	....	....	....	1	1	3	....	......	....	....	....	....	3	4
Nevada	135	6	....	6	7	19	32	....	......	1	....	....	....	33	52
Placer	116	9	....	34	31	74	15	....	......	....	....	....	....	15	89
Plumas	118	26	....	6	36	68	12	....	......	....	....	....	....	12	80
Riverside	21	....	....	....	2	2	4	....	......	....	....	....	....	4	6
Sacramento	5	....	7	2	3	12	....	....	......	....	....	....	....	....	12
San Bernardino	48	....	....	....	1	1	11	6	1	6	1	....	1	26	27
San Diego	47	....	....	....	1	1	6	....	......	....	....	....	....	6	7
San Luis Obispo	1	....	....	....	3	3	....	....	......	....	....	....	....	....	3
Shasta	119	....	1	....	7	8	23	....	......	4	....	....	....	27	35
Sierra	105	14	....	18	8	40	12	....	......	....	....	....	....	12	52
Siskiyou	190	66	....	4	37	107	36	....	......	....	....	....	....	36	143
Sonoma	1	....	....	....	....	....	....	....	......	....	....	....	....	....	......
Stanislaus	......	....	....	....	1	1	1	....	......	....	....	....	....	1	2
Tehama	1	....	....	....	....	....	....	....	......	....	....	....	....	....	......
Trinity	107	37	....	3	12	52	19	....	......	....	....	....	....	19	71
Tulare	5	....	....	....	....	....	....	....	......	....	....	....	....	....	......
Tuolumne	87	1	....	2	2	5	35	....	......	....	....	....	....	35	40
Yuba	31	2	13	1	27	43	6	....	......	....	....	....	....	6	49
Total	2,001	193	57	106	262	618	408	6	1	20	5	2	1	443	1,061

PRODUCTION BY INDIVIDUAL COUNTIES.

AMADOR COUNTY.

Amador is the leading producer of the Mother Lode counties of California, and one of the 5 counties of the State which made a total yield valued at over $2,000,000 in 1907. Its mines are mainly quartz mines, few placers being worked. The record of the county in bullion output in the last two years is as follows:

Metallic production of Amador County, Cal., in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		
1906	109,345.69	$2,260,376	21,760	$14,579	8,648	$1,669	$2,276,624
1907	102,370.30	2,116,182	20,477	13,515	5,300	1,060	2,130,757
Decrease	6,975.39	144,194	1,283	1,064	3,348	609	145,867

With regard to the production of gold, silver, and copper, as shown in this table, it is to be noted that the falling off in yield in 1907 is about the same as it was in 1906 from 1905. The idleness of some of the larger mines, notably the Wildman-Mahoney, of Sutter Creek, and the Oneida, at Jackson, was partly responsible for this lessened yield, though there was a small yield from the last-named property in 1907 before it was permanently closed down.

One operator of important mines in this county persistently declines to furnish a statement of production to the Geological Survey.

This necessitates an estimate, which may, of course, affect the rank of the county as given in the official tables of bullion output.

At Amador City is one of the oldest of the quartz mines in California—the property of the Keystone Consolidated Mining Company. It is equipped with a 60-stamp, plate-amalgamation mill with concentrators, but this was closed down in February, March, and April, 1907, on account of inadequate machinery for pumping mine water. During the rest of the year only half of the stamps were in use. The Bunker Hill Consolidated Mining Company's property is at the same place, and it is equipped with a 20-stamp, plate-amalgamation mill with concentrators. At Defender are a few producers and a number of mines held under assessment work. Near Drytown is the extensive property of the Fremont Consolidated Mining Company, which has 2 incline shafts 1,400 and 1,550 feet deep, respectively, and upward of 3 miles of drifts. The Gover mine is included in this property. The reduction plant consists of a 40-stamp mill, with plate amalgamation, and 16 Frue concentrators. The property was reopened in 1908. At Ione there is a copper mine owned by the Newton Copper Company, which has an 80-ton water-jacket furnace and steam hoisting works. The mine has been idle a number of years, though the old dumps have been leached for the past thirty years or more, and small lots of cement copper sold to sundry markets. At Jackson are a number of important mines, the principal one of which is owned by the Kennedy Mill and Mining Company, now the second largest producing gold mine in the State. The mine is very fully developed, and has 1 vertical shaft 3,254 feet deep and 2 other vertical shafts, respectively 2,200 and 2,300 feet deep. The plant consists of a 100-stamp, plate-amalgamation mill with concentrators, slimes plant, and chlorination works. At the same place is the Argonaut Mining Company, with a 40-stamp mill, and the Zeila Mining Company, with the same number of stamps. The Oneida Mining Company closed down permanently both mine and 60-stamp mill on May 31, 1907, the venture being considered unprofitable after many years of work. There are several small producing mines in the neighborhood of Jackson. At Lancha Plana are some small quartz and placer mines. A few drift and sluicing mines are being worked productively at Oleta, and there are also several idle properties. The few mines worked at Plymouth are quartz mines. At Pine Grove, where the Gold Top hydraulic mine has been virtually closed for a year, the dam has been completed to retain the débris, and operations were resumed in the season of 1908. The Central Eureka Mining Company at Sutter Creek has a 40-stamp mill, and the incline shaft is 2,500 feet deep on the slope. At the same place the South Eureka Mining Company has an incline shaft 2,500 feet deep, with a 100-foot winze below that. The mine has a 20-stamp mill with concentrators. The Wildman-Mahoney mines at this place still continue unproductive, and the large mills are idle. The drift and sluicing mines at Volcano, worked by white and Chinese miners, are none of them large producers.

The record of output of the county is a remarkably good one, considering that there were only 36 producing properties, of which 22 were deep gold-quartz mines, and 1 a copper mine, the remainder being producing placers of various kinds. The tonnage of ore in Amador County in 1907, was by far the largest of any county in the State, being 444,341 tons, all siliceous ore. Yet this was 135,258 tons less than the ore output of the county in 1906, and accounts to some extent for the reduced yield of $144,194 in gold, and $1,064 in silver in 1907, as compared with 1906. The average value of these siliceous ores was $4.76 per ton in gold and silver. The placers of the county only yielded $15,833 in gold and $49 in silver in 1907.

BUTTE COUNTY.

Butte County, now the leading county of California in the production of gold, shows a decrease in output in 1907 as compared with 1906, of $229,907 in gold and $1,886 in silver, a total of $231,793. This was largely due to reduced yield of the dredges at Oroville, as hereinafter explained. There were but 3 small quartz mines producing in the county in 1907, all at Inskip, the other producers of the county being gravel mines of different kinds. Of the 72 mines reporting product, 69 are placers, 3 of which are hydraulic, 9 drift, and 22 surface or slucing placers. There were 35 gold dredges in operation, all at Oroville. Ninety-one mines in the county reported no product in 1907.

At Bangor the South Honcut hydraulic is the only productive mine. At Berdan the mines are all worked by drifting, most of them on land patented to the railroad companies. The Big Butte Dredge Mining Company, at this place, has changed its name to that of the Royal Channel Gold Mining Company. At Brush Creek 3 placers are producing small amounts yearly, and at Clipper Mills only small placers are being worked. The Bear Canyon Mining Company proposes to build a mill in 1908. At Cherokee the Cherokee Mining Company is operating an extensive hydraulic mine, but some of the old mines have been abandoned. Near Chico the Gold Bar Dredging Company has built a "dry-land" dredge to operate on bench gravel, and began active operations in the latter part of 1907. The mines near Enterprise are nearly all idle, though a few placers yielded a small amount in 1907. In the quartz camp at Forbestown, where formerly there were some large producers, notably the Gold Bank, no mines produced in 1907. The Carlisle mine is being operated under bond, and the mill will probably start in 1908. Near Inskip some marked improvements have been shown during the year 1907, and there are a number of producers, all placers, the principal one of which is the Sky High, operated by the hydraulic process. A number of small properties are being worked with light production and considerable development work is being done on larger claims. The outlook for that section seems brighter than for many years.

There are numerous mines at John Adams district, though but few producers, all of which are small placers and mainly drift mines. None of the mines at Lumpkin have returned any production for 1907. In the Magalia district the Cape Horn drift and the Ramsay Bar are the principal producers. At the Cape Horn mine a new incline is being sunk to open up the property on a much larger scale than formerly. At the Snow mine work has been done for several years on a bedrock tunnel to get into the channel, and it is expected that a good showing will be made in the returns for 1908. The P. B. Steifer Mining Company, a drift property, has completed an electric power pumping plant, and will probably produce in 1908. In

Nimshew district the Dog Hill and Indian Springs drift mine is the largest producer. The Sunset, also a drift mine, is another important producer. At the Alvarado drift mine a new tunnel is being run to get into the channel, and this mine will probably produce more gold in 1908 than in 1907.

The dredge diggings at Oroville are by far the largest source of gold in Butte County, as well as in the entire State of California, the dredges at that place in 1907 having produced gold valued at $2,697,092 out of the total of $2,786,840 in the county.

The following table shows the output of gold from the dredging field at Oroville for several years past, with the annual increase or decrease:

Production of gold by dredging in Butte County, Cal., 1903–1907.

Year.	Value.	Increase.	Decrease.
1903	$1,329,998		
1904	1,632,507	$302,509	
1905	2,261,887	629,380	
1906	2,768,782	506,895	
1907	2,697,092		$71,690
Total	10,690,266		

The reason, in part, for this falling off in output in 1907 as compared with 1906 is that during the floods in the spring of 1907 2 dredges in the field were wrecked altogether and several others were damaged to such an extent that they were put for a number of months under repairs. Moreover, as has already been stated, some of these companies have worked out their best ground and are running in gravel not so rich as that upon which work was begun. There were in the Oroville field 35 dredges operating in 1907. The Butte Gold Dredging Company had 1; the El Oro Dredging Company, 2; the Feather River Development Company, 4; the Gardella, 1; the Garden Ranch Dredge Company, 1; the Gold Run Dredging Company, 1; the Indiana Dredging Company, 2; the Leggett Gold Dredging Company, 1; the Nevada Gold Dredging Company, 1; the Ophir Gold Dredging Company, 1; the Oroville Dredging, (Limited), 9; the Oro Water, Light, and Power Company, 6; the Pacific Gold Dredging Company, 3; the Pennsylvania Dredging Company, 1; and the Viloro Syndicate, (Limited), 1. Since the close of 1907 the Feather River Development Company has been operating 5 dredges instead of 4. The Garden Ranch Dredging Company has given up business. The Indiana Gold Dredging Company lost 2 dredges in the flood of 1907, and started building a new dredge. The company only operated during two and a half months in 1907. The Nevada Gold Dredging Company sold its dredge to the Ophir Dredging Company in 1908, so the latter now has 2 dredges. The Oroville Dredging, (Limited), has 10 dredges in 1908, a new one having been built. The Pacific Gold Dredging Company is now operating 4 dredges instead of 3, having started a new dredge in January, 1908. The Pennsylvania dredge, like some others, was inactive about half the year 1907, owing to damage done by floods in the spring of that year. As several new dredges were built in 1908 and the others damaged in

1907 have been repaired, the Oroville field will doubtless make a better showing in gold output for the year 1908 than for 1907.

The Morris Ravine mine, near Oroville, now owned by W. Fabian, was prospected and developed during 1907, but no production was made. There are no mines of any importance at West Branch, Wyandotte, or Yankee Hill.

CALAVERAS COUNTY.

Metallic production of Calaveras County, Cal., in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		
1906	79,539.82	$1,644,234	110,597	$74,099	5,082,320	$980,888	$2,699,221
1907	53,114.49	1,097,974	82,454	54,420	4,386,243	877,249	2,029,643
Decrease	26,425.33	546,260	28,143	19,679	696,077	103,639	669,578

In 1907 Calaveras County, which is one of the Mother Lode counties of California, produced only 251,613 tons of siliceous ore and 43,828 tons of copper ore, as compared with 538,566 tons of siliceous ore and 44,641 tons of copper ore in 1906. The falling off in tonnage for the year 1907 was equal to about one-half of the output of 1906. It was due to the fact that miners' strikes at Angels closed down certain properties, and it accounts for the materially lessened yield of metal in 1907, as shown by the preceding table. The main decrease was in gold, as stated. The siliceous ore yielded in gold, in 1906, 65,689.52 fine ounces, valued at $1,357,923, and in 1907 it yielded 45,078.29 fine ounces, valued at $931,851. This was a decrease from this source, in gold, of 20,611.23 ounces, valued at $426,072. The placers yielded, in 1906, $227,017 in gold and in 1907 $111,906, which is a decrease in placer gold for the year of $115,111. The rest of the decrease in gold was due to lessened output from the copper ores, the value of the decrease amounting to $5,077. The principal reduction in total output was in the quartz mines at Angels, where a falling off of $289,855 is apparent, due largely to closing down on account of miners' strikes. Two other of the very large quartz mines in the county show a combined reduction in output in 1907 from 1906 of $243,877. A dredging company, which produced largely in 1906, only worked a portion of the time in 1907, so that the yield from that source was also materially lessened.

There were 77 producing mines in the county in 1907, of which 48 were deep mines, 3 being copper mines. The producing placers numbered 29, of which 1 was hydraulic, 1 dredge, 7 drift, and 20 sluicing properties. Reports were received from 156 nonproducing mines.

Angels is the gold-producing center of the county, where the largest quartz mines are situated. The Angels Mining Company, with a 40-stamp mill, is the most productive property, though it was closed for 5 months of 1907 owing to a miners' strike. The Benson Mining Company only worked a few months of the year. The Lightner Mining Company has a 60-stamp mill, with plate amalgamation and concentrators, and added 20 stamps in November, 1907. This mine was closed by reason of miners' strikes for 5 months of the year. The Utica Mining Company worked both the Stickle and the Gold Cliff mines in 1907, though the Stickle was closed down from April 20 to November 30, and no ore was milled between those dates. The Gold Cliff mine milled no ore from March 20 to December 31, 1907. This cessation of work was due in both instances to miners' strikes. At the Stickle the Cross shaft is down 1,400 feet in the vertical, and the Gold Cliff shaft is 900 feet deep on a 45-degree incline. The Stickle mill of the Utica Company has 100 stamps, with plate amalgamation, concentrators, etc., and the Gold Cliff mill, similarly equipped, has 40 stamps. At Campo Seco are the properties of the Penn Chemical Company, consisting of the Satellite, the Hecla, and the Campo Seco mines, where there are 2 incline shafts over 750 feet deep and another 500 feet deep. The copper ore, carrying both gold and silver, is treated in reverberatory and blast furnaces having a combined daily capacity of 225 tons. The Union Copper Mining Company, at Copperopolis, is working the Union, the Keystone, and the Empire mines by a shaft 328 feet deep in the vertical and then inclined to a total vertical depth of 570 feet, with crosscuts and drifts. The reduction plant consists of a 100-ton reverberatory furnace and a 300-ton concentrator, the latter newly completed in 1908 and not operated in 1907. No gold or silver is produced from this copper ore. The matte produced is shipped to the Chicago Smelting and Refining Company. At Gwinmine post-office is the Gwin Mine Development Company, a large producer, with a 100-stamp, plate-amalgamation mill and concentrating vanners, etc. This mine is developed by a shaft 2,533 feet deep, including depth to bottom of sump. From the 2,460 level a winze is used for the present to develop the ore bodies on the 2,600 and 2,800 foot levels of the mine. At Jenny Lind a dredge was operated only part of the year 1907 by the Calaveras Gold Dredging Company, and a new dredge is being built in 1908 by the National Dredging Company. At Melones is the property of the Melones Mining Company, which was closed down during most of the year 1907 owing to a break in the flume which cut off the water supply. This mine has a 100-stamp mill, with concentrators, etc. Near Milton is the Napoleon copper mine, the ore from which, carrying also gold and silver, is treated by the Peyton Chemical Company. At Mokelumne Hill the principal producers are the Esperanza (formerly the Boston) quartz mine, the Hamby, the Outlook, the Gobi pocket mine, the Duryea gravel mine, and the McSorley & Shockley pocket mine. There are many small mines worked in this region. From the pocket mines of the Rich Gulch region, near Mokelumne Hill, considerable gold was recovered in 1907. At Mountain Ranch there was a very small production, though considerable activity is being shown in the district in 1908. At Murphy very little productive work was accomplished in 1907. At Northbranch the Reed drift gravel mine was a large producer during the year. From Railroad Flat 2 small producers reported. No large producers made returns from San Andreas, though a number of small mines are being worked. At Sheep Ranch are the 22 grouped claims of the Sheep Ranch Consolidated Mining Company, where there is a 20-stamp mill, with plate amalgamation. On the Sheep Ranch mine of the group there is a shaft 1,300 feet deep, with a winze which makes a total depth of 1,565 feet. There are also 3 incline shafts of less depth. At this same place are the producing hydraulic mines of the Moosehead Water, Power and Mines Company. The Old Stiff Gravel, the Hambleton quartz, and the Fine Gold Mining Company (drift) mines were the only producers in 1907 at Vallecito. At Wallace the Mokelumne Mining Company is reconstructing its dredge and installing electric power. There was no output in 1907. There were several small quartz producers at West Point.

ELDORADO COUNTY.

Eldorado, one of the 5 Mother Lode counties of the State, produced in 1907 gold valued at $319,177 and silver valued at $2,301, a total of $321,478. This is a decrease from the figures of 1906 of $112,569 for gold and of $389 for silver, a total decrease of $112,958 for the year.

One mine owner in the Mother Lode belt in this county refuses to give any information of production to the United States Geological Survey. The actual rank in bullion production of this county is therefore in doubt.

Reports were received from 61 producing mines, of which 30 were deep mines yielding siliceous ore and 31 were placers, consisting of 5 hydraulic, 10 drift, and 16 sluice mines. At Coloma, Diamond Springs, Eldorado, Fairplay, and Garden Valley there are a few producers, but none specially noteworthy. At this place there are a number of producers, but a much larger number of idle mines. Among the productive properties are the Bald Mountain pocket mine, the Beatty Seam, the Crane Gulch pocket, the Franklin placer, the Jones Hill gravel, the Tipton Hill drift, and the Two Channel drift mine. Greenwood has one producing placer, and Green Valley has a number of small producing placer mines. Grizzly Flat, Indian Diggings, Jurgens, and Lotus have very few producers. The New Montezuma mine, at Nashville, is a large producer and has a 10-stamp, plate-amalgamation mill with concentrators. The incline shaft is 1,200 feet deep. The Monarch mine, at the same place, is equipped with a 10-stamp mill with concentrators and an incline shaft 500 feet deep. The Lone Star mine at this place is also a producer. The Baltic group, at Park, made some yield in 1907, as did the Holland pocket mine at Pilot Hill. Two small placers are being worked at Pino Grande. Around Placerville are a number of quartz and gravel properties, several of which are productive. The Excelsior quartz mine, owned by the Eldorado Water and Deep Gravel Mining Company, is developed by a tunnel 2,874 feet long, and is equipped with a 10-stamp mill. The mine is the largest producer in the vicinity. The Sherman Mill and Mining Company has a small mill with concentrators, and in addition to the 538-foot shaft has 5,000 feet of drifts and crosscuts. Most of the gravel mines around Placerville are small producers, yet their aggregate yield is large. They are worked by both whites and Chinese. At Rescue there are 3 small placers which are productive. The Pyramid Gold Mining Company is the principal producer at Shingle. It is equipped with a 15-stamp mill with plate amalgamation and concentrators. The mine was only worked a short time in 1907.

HUMBOLDT COUNTY.

Humboldt County produced in 1907 gold valued at $40,109, silver valued at $214, and 980 pounds of copper, valued at $196, a total value of $40,519. This total was less in value by $8,014 than in 1906, the falling off being mainly in gold, in which the decrease was $8,186. Aside from a small copper mine, the yield was entirely from placers, of which there were 22 productive, 4 being surface placers, and 18 worked by the hydraulic process. The larger number of mines being operated are at China Flat. They obtained, in addition to their gold, about $500 worth of platinum, which was sold in different markets. There are a few small placers at Hoopa. At Orleans Bar the Orleans Bar Mining Company, now named the California Mining and Dredging Syndicate, is the largest producer. The bench gravels are worked by the hydraulic process, but a shortage of water caused a smaller yield in 1907 than usual. The Pearch hydraulic mine at this place is another producer of some importance, as is the Salstrom, the others being smaller operations. At Weitchpec the mines are all small placers. Most of the returns received from placers in this county show small quantities of platinum saved. Near Orleans a number of copper prospects are being opened, and from one of them a small test shipment of ore was made.

INYO COUNTY.

The value of the production of metals in Inyo County in 1907 was $57,241 in gold, $44,440 in silver, $3,117 in copper (from 15,587 pounds), $137,609 in lead (from 2,596,399 pounds), and $13,779 in zinc (from 233,550 pounds), a total of $256,186. This is an increase over the value of the production of 1906 of $37,792 in gold, $31,082 in silver, $2,317 in copper (or 11,442 pounds), $125,752 in lead (or 2,388,381 pounds), and $13,779 in zinc (or 233,550 pounds), a total increase in value for 1907 of $210,722. No placers were worked in the county in 1907, but there were 17 productive deep mines, of which there were 11 whose principal yield was gold, 1 whose yield was chiefly copper, 4 that produced lead, and 1 which produced zinc. The total tonnage was 17,684 short tons. As compared with a production of 3,401 tons in 1906, an increase is shown for 1907 of 14,283 tons, which accounts for the increase in total yield. The increase in siliceous ore was 5,015 tons, in lead ores 6,469 tons, and zinc-lead ores 2,800 tons. There was no output in zinc for the county in 1906. The main increase in the lead output was largely due to the operations of the Tecopa Mining Company, at Tecopa, which made no production in 1906. Very few returns were received from the camp at Ballarat, which a few years ago produced rather largely; most of the mines were idle in 1907. At Big Pine the principal producer was the Montezuma Mining and Smelting Company, though it was practically closed down a portion of the year. The output is mainly in lead and silver with smaller values in gold. The ore was shipped to smelters at Salt Lake City. No returns of production were received from the Bishop Creek section, though a number of mines are in process of development. Among them the most notable is the Black Canyon property. At Darwin the New Coso Mining Company is producing from the Lucky Jim mine, the yield being in silver and lead, and the ore being sold to smelters. There are a number of idle mines at this place. The copper camp of Greenwater, about which there was considerable excitement in 1906, made only a nominal output in 1907, most of the mines being idle. The Tonopah and Tidewater Railway passes within 15 miles of the camp, and will eventually assist its development. In June, 1908, some strikes were made at Greenwater which renewed interest in the district. At Independence the mines were closed down and idle in 1907, no production being reported. Keeler, Cerro Gordo district, had a few producers in 1907, the principal one of which was the Great Western Ore Purchasing and Reduction Company. Some of the old mines in this section are being reopened and worked again after years of idleness, and a general mining revival is expected. The Inyo Copper Mines and Smelter Company have made no shipments, owing to high transportation costs. Rail connections and reduction works are projected so that active development continues. At Laws there is only one company producing. The Southern Belle Mining Company did not run its 10-stamp mill in 1907, though ore was taken out from the 2 shafts, respectively, 400 and 265 feet deep. The Tecopa Mining Company at Tecopa, though a new company in 1907, is now the largest producer in the county. It is working the Gunsight mine through a 1,200-foot tunnel and the Noonday through a 200-foot incline shaft. These two mines are 1½ miles apart but in the same formation. The mines were worked only part of the year, being closed down pending the building of a concentrator, but started up again in June, 1908. Some other properties of the company are being worked by lessees. The Tonopah and Tidewater Railroad runs within a few miles of the mines. The ore is a perfect flux and is much in demand by the smelters at Salt Lake City, to which place it is shipped. The lead ore carries considerable silver and about $1.80 per ton in gold. At Tinemaha the producing mines are few.

Information as to production was readily furnished to the United States Geological Survey by all of the mining companies, except one large producer in the Death Valley region. Estimates, when necessary, are rather made too low than too high, and it is possible that this refusal has affected the rank of the county in the official tables.

The Arondo Gold Mining Company in the Argus Range, 20 miles from Kern County, continues to be an important producer. There are several newly opened camps in this county in which more or less development is being carried on since the close of 1907. At Skidoo several companies are carrying on active work, and many lessees are at work. Some of the properties are already down to the 500-foot level. The principal company is the Skidoo Mines Company, which has one vertical shaft 340 feet deep and an incline 420 feet. It has several tunnels from 185 to 485 feet long. A 10-stamp mill has been erected with plate amalgamation and concentrators. The tailings are to be reground in a tube mill and cyanided. The company owns 30 claims. Skidoo is really in Wild Rose district, and has been an active camp since its discovery within a year. In Lee district, 25 miles south of Rhyolite, Nev., many locations have been made, and the Hayseed Mining Company has become a producer since the close of 1907. The ore bodies of Kruger and Burgess, both in the Inyo Mountains, east of Keeler, were discovered during 1908, and some of the mines are being worked under lease. The greatest activity is at Kruger. Ten miles east of Wingate Pass in Hidden Spring district gold ore was discovered in 1908. The building of the Tonopah and Tidewater Railroad through this county is having the effect of bringing in many prospectors, and mines long idle are again being worked, now that transportation for supplies and ores is available at comparatively reasonable rates.

KERN COUNTY.

Gold and silver production in Kern County, Cal., in 1906 and 1907.

Year.	Gold.		Silver.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		
1906	38,995.91	$806,117	193,288	$129,503	$935,620
1907	42,511.85	878,798	130,353	86,033	964,831
Increase (+) or decrease (−)	+3,515.94	+72,681	−62,935	−43,470	+29,211

The increase in gold output in Kern County in 1907, as compared with 1906, and the falling off in silver show as a net result an increase of $29,211 in value for the year. The decrease in the silver output was entirely due to the closing down of the Zada mine, at Amalie, in 1907. The tonnage of the county in 1907 was all of siliceous ore and amounted to 236,853 tons, an increase of 90,777 tons for 1907. This increase in tonnage came mainly from the Yellow Aster mine at Randsburg. There are 40 producing mines in the county, all quartz mines except 3, which are small placers. At Bodfish are 3 producers, of which the Portuguese is the largest. At Havilah there are at present but few producers. Some of the old mines closed down since 1875 are, however, being reopened, among them those formerly owned by Haggin & Hearst. Both the Mammoth and the Whitney View mines have been equipped with mills during 1908.

The Piute Consolidated Mining Company is about to erect mills on some of the claims, and the Rand Hill mine is being reopened. The Kern River Mining, Milling, and Development Company is working its claims and expects to produce in 1908. At Isabella, Kernville, and Kern the few producing quartz mines are small ones.

At Mohave the Queen Esther Mill and Mining Company, which is a large producer, has rolls for crushing its ore to the extent of 125 tons daily. It has also a large cyanide plant, from which the precipitates and slimes are shipped to the Selby smelting works. The Mohave Mining Company found its ore difficult to treat and has consolidated with the Karma-Ajax Consolidated Mining Company. It had a 20-stamp mill and complete cyanide plant, but made no production in 1907. The Karma-Ajax Consolidated Mining Company now owns the Karma, the Ajax, the Extension group, and the Double Standard group. The properties made no output in 1907. At Piute the principal mines producing are the Bowman and the Kern County Consolidated Gold Mines, the latter of which has a 3-stamp mill. At the same place the Jeanette has a 4-stamp mill, and the Mace has a steam arrastra.

Randsburg is the principal camp of Kern County, the producers at which are the King Solomon group, Butte Lode Mining Company, Consolidated Mining Company, G. B., Gold Brick, Merced Mining Company, Napoleon Consolidated Mining Company, Sidney Annex group, Sunshine, Gold Coin and Standford, and Yellow Aster Mining Company. The King Solomon mine was formerly owned by the Ashford Mining Company, but is now the property of J. J. Miller. Most of the ore of the mines was milled at custom mills in the district, but the Gold Coin and Stanford mine has its own 10-stamp mill with plate amalgamation, but without concentrators. The Yellow Aster Mining Company, the largest producer in the county and in the southern part of California, owns 42 patented claims. The shafts are sunk 600 feet and there are about 15 miles of tunnels and upraises, and also 3 "glory holes," or quarries. The company has 2 mills of 100 and 30 stamps, respectively, with plate amalgamation and concentrators. It is contemplated to add 500 stamps to work the large bodies of low-grade ore found in the mine. To facilitate transportation of the new machinery to the new mill site near Randsburg, the Santa Fe Railway Company will extend its line from Johannesburg, a distance of 1½ miles. The advent of the Southern Pacific's Owens River Railway, passing through the Randsburg and the Rademacher districts, is bringing much activity to this section, and the country within a radius of 40 miles is being thoroughly prospected. Measures are also being taken to provide a larger water supply for milling purposes. In the White River district of this county a few small quartz mines are making some production.

MARIPOSA COUNTY.

Mariposa is one of the 5 Mother Lode counties of the State where quartz mining was pursued in very early days after the gold discovery and before much attention was paid in other counties to deep mining. There are, however, only 24 mines being worked productively in Mariposa, of which 22 are deep mines and the others small placers. Two of the deep mines are yielding copper ores, and other deposits of that metal are known, but not yet brought to a producing stage. In 1907 Mariposa County produced 19,615.96 fine ounces of gold, valued at $405,498, and 6,288 ounces of silver, valued at $4,150. The copper amounted to 7,984 pounds in quantity and to $1,597 in value. The value of the total output for the county in 1907 was $411,245, which is an increase of $41,474 over the value of the output of 1906. Of this increase $39,104 was from gold alone, the increase in value of silver being $773, and that of the copper being $1,597. There was no copper yield in the county in 1906. The number of tons of siliceous ore mined in 1907 was 51,076 and of copper ores 63 tons. Of the gold and silver, the placers yielded $909 in gold and $3 in silver. The 51,076 tons of siliceous ore yielded $408,711 in gold and silver, an average value of $8 per ton. By plate amalgamation at the mills values of $351,884 in gold and silver were saved, an average value of $6.89 per ton. Out of this tonnage 643 tons of concentrates were saved, valued in gold and silver at $56,827, an average of $88.38 per ton. Both the productive copper mines of the county are in Green Mountain mining district, near the post-office of Ben Hur. These are the Cavin Mining Company and the Mammoth mine. There are several claims in each of these properties, and test shipments were made in 1907 to the Peyton Chemical Company by both companies. At Coulterville the producers are the Flyaway group, the Hill, and the Tongas Condo pocket. The Bondurant, with its 10-stamp mill, was idle during the year, as were a number of other mines at Coulterville. At the Mammoth, at the same place, which was idle in 1907, the mill was remodeled in 1908, and production was commenced again. The Ruth Pierce Mining Company, at Hornitos, a large producer, has a 10-stamp mill with plate amalgamation and concentrators. The Mount Gaines Consolidated Mining Company, also a large producer, at Hornitos, is developed by an 860-foot incline shaft. The mill has 20 stamps, with 9 concentrators, all new in 1907. This is an old mine that was twice worked and twice abandoned, and is now made productive again in 1907, after a period of idleness. The Exchequer mine has put in a dam and power plant and commenced producing since the close of 1907. The old Hite mine at Jerseydale, idle for several years, has a 20-stamp plate-amalgamation mill, with concentrators, and a cyanide plant in course of construction in 1908.

At Kinsley the St. Joseph mine was a small producer. The Omparissa Gold Mining Company did development work during 1907, and after reaching the ore bodies started milling early in 1908. The mine is equpped with a 10-stamp mill and 4 Nissen mills. At Mariposa there are only a few small producers, most of the mines being held by assessment only. At Mount Bullion the Mariposa Commercial and Mining Company is working the Princeton mine and treating the ore in the 50-stamp plate-amalgamation mill. The Greens Gulch and several other mines in the Mariposa grant owned by this company are worked by lessees, and the ore is sent to the Princeton mill. The Josephine mine near Bagby, another property of this company, is a producer, and the ore is crushed in a small mill on the Merced River. It is expected that the mines on the grant will be worked more extensively in 1908, especially by lessees, as more milling facilities are being provided. At Whitlock several small quartz mines are being operated.

MONO COUNTY.

In 1907 Mono County produced 18,574.60 fine ounces of gold, valued at $383,971, and 45,147 ounces of silver, valued commercially at $29,797, a total value of $413,768. This is an increase over 1906 of $45,273 in gold and of $16,646 in silver, a total increase of $61,919. All the ore treated was siliceous and amounted to 32,363 tons, an increase over the output of 1906 of 3,764 tons.

The principal mining center of Mono County is Bodie, where the most productive mines are situated. The largest producer at this place and in the county continues to be the Standard Consolidated Mining Company, the properties of which are extensively developed, most of them being mines that have been worked for many years. The company treats its ores in a 20-stamp plate-amalgamation mill and cyanide plant, in the latter of which the slimes and mill tailings are treated. Part of the bullion produced is derived from treating an accumulation of old tailings. The New Bodie Mining Company is an important producer, and considerable ore is taken out by lessees from the Snowflake mines. It is now thought that there is a large amount of free-milling low-grade ore in the ground south of the

Standard Company's holdings, but nothing has yet been done to work it. Very little is being done at Bridgeport. At Lundy are the properties of the Crystal Lake Gold Mining Company, which are being developed by tunnels, the longest and lowest of which is 4,900 feet long. The company has a 20-stamp plate-amalgamation mill with concentrators. The cyanide plant was destroyed by a snowslide in March, 1907, and was not rebuilt during the year. The production of the mines in 1907 was small, and mainly from concentrates and tailings, most of the work done being of a development character, in the direction of connecting the deep tunnel with the workings above by an 1,800-foot upraise. In Masonic district the Pittsburg Liberty Mining and Milling Company is the only producer. There are numerous other properties, but they are all idle. In Antelope Valley the Golden Eagle mine is idle. Large power plants are projected on the West Walker River, the sites having been purchased for this purpose, but litigation will prevent the prosecution of active work for some time to come and thus retard mining development. Mono is to a certain extent an isolated county, and it seems difficult to get capital to investigate its numerous mining properties.

NEVADA COUNTY.

Metallic production of Nevada County, Cal., in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		
1906	128,601.06	$2,658,420	36,147	$24,219	....	....	$2,682,639
1907	104,590.76	2,162,083	25,522	17,505	22,111	$4,422	2,184,010
Increase (+) or decrease (−)	−24,010.30	−496,337	−10,625	−6,714	+22,111	+4,422	−498,629

From this table it will be seen that in Nevada County the value of the total metallic output in 1907 shows a decrease of $498,629 as compared with the value of the yield for 1906. The tonnage treated in 1906 was 276,602 short tons, while in 1907 it was 227,288, a reduction in quantity for 1907 of 49,314 tons. Fifty-two mines were operated productively, of which 32 were deep mines, 1 of these being copper and the others gold and silver mines. There were 19 productive placers, of which 6 were hydraulic, 6 drift, and 7 surface sluicing mines. The placers of the county yielded in 1907 $131,807 in gold, and the deep mines yielded gold worth $2,030,276. The operation of the laws against hydraulic mining closed down some years ago a number of large producers of this class in the county.

Of the siliceous ore produced in the county in 1907 there were 225,830 tons milled, and 1,787 tons were shipped to smelters. The tonnage milled yielded a total of $2,046,594 in gold and silver, an average of $9.06 per ton. In 1906 the average value per ton of these milling ores was $8.74. In the operations of 1907, out of 225,830 tons of ore, 4,149 tons of concentrates were obtained, valued at $241,397 in gold and silver, an average value of $58.18 per ton. In the milling operations of the county there was saved on the plates $1,805,197 in gold and silver, an average of $7.99 per ton.

The largest output in Nevada County comes from Grass Valley district, which includes the mines at both Grass Valley and Nevada City. This has always been considered the quartz mining center of California, not only in production, but also because the mines are fully developed and equipped with the most modern appliances for both mining and milling. The returns for the last two years in this district from the quartz mines were as follows:

Production of Grass Valley and Nevada City quartz mines, Nevada County, Cal., 1906 and 1907.

Year	Grass Valley mines.			Nevada City mines.		
	Gold.	Silver.	Total.	Gold.	Silver.	Total.
1906	$2,196,990	$16,516	$2,213,506	$133,031	$5,755	$138,786
1907	1,744,752	11,200	1,755,952	219,514	5,379	224,893
Increase (+) or decrease (−)	−452,238	−5,316	−457,554	+86,483	−376	+86,107

From this table it may be noted that of the decrease in the gold yield of the whole county in 1907, amounting altogether to $496,337, the quartz mines of Grass Valley were responsible for $457,554. The Nevada City mines, on the other hand, showed an increase of $86,483. At Grass Valley is the most important and most productive gold mine in California, that of the North Star Mines Company. The property is developed by an incline shaft 5,000 feet down and a vertical shaft 1,600 feet deep, which cuts the incline at 4,000 feet. The property is equipped with two 40-stamp, plate-amalgamation mills, with concentrators, and two extensive cyanide plants. At the central plant the cyanide process has been successfully adapted to the treatment of the sulphuret product of the mills, and yields better economical results than were obtained formerly by chlorination or smelting. The total value of the gold and silver produced from the North Star mine during 1907 was obtained from 78,366 tons of ore milled, with an average yield of $11.96 per ton, at an average cost of $5.09 per ton for current operation and $1.18 per ton for development, making an aggregate cost of $6.27 and leaving a realized profit of $5.68 per ton over all costs of operation and development. Outlays during the year for improvements and property purchase amounted, per ton, to 54 cents, leaving a net mining profit, over all outlays, in cash surplus, of $5.14 per ton of ore. The ore tonnage produced in 1907 was about 6,300 tons less than in 1906 by reason of a labor strike which interrupted productive operations during January and February, 1907. Fortunately the improved quality of the ore more than compensated for the decrease in quantity, so that the value of the output for 1907 considerably exceeded that of any previous year.

During 1907 the deep or lower North Star mine, comprising all workings below the 2,700-foot level and operated through the central vertical shaft, produced 57,155 tons of ore yielding $641,018.19, an average of $11.21 per ton, at an operating cost of $269,898.05, or $4.72 per ton, and a resulting profit of $371,120.14, or $6.49 per ton. Additional outlays for development and prospecting work in the lower mine during 1907 amounted to $57,295.94, or $1.00 per ton, making for operation and development together a cost per ton of

$5.72, and leaving a net mining profit of $313,824.20, or $5.49 per ton of ore. These deeper levels are now the main sources of current production. The drifts on the 4,400 and the 4,700 levels in both directions show a vein of profitable character and some rich ore. The incline shaft is 5,000 feet from the outcrop, measured on the dip of the vein, or 2,000 feet on the vertical. The North Star mine in its career of nearly 50 years has been more or less continuously ore-bearing from the surface to the present bottom, nearly a mile deep on the dip of the vein. The production of ore in 1907 was contributed from practically all the levels opened in the mine at depths varying from about 1,500 to 5,000 feet below the outcrop.

The Empire Mines is another of the more important producing properties at Grass Valley, very completely developed, and having a 40-stamp mill and all accessories. The Brunswick Consolidated Gold Mining Company is another large producer, having a vertical shaft 1,250 feet deep and a 20-stamp plate-amalgamation mill with concentrators, etc. The Central Consolidated Mining Company has a 20-stamp mill with plate amalgamation, concentrators, and slime plant. It is developed by a vertical shaft 400 feet deep and a 1,200-foot tunnel. This mine was worked with considerable success in the early "sixties," but since then, up to the time the present company purchased it, very little work upon it has been done. The Sultana Mining Company, another large producer, has a 20-stamp, plate-amalgamation mill, with concentrators, and slime plant. Among the other producers of note at Grass Valley are the Cassidy Consolidated Mining Company, the Conlin Gold Mining Company, the Idaho-Maryland Development Company, the Kenosha Mining Company, the Pennsylvania Mining Company, and a few smaller properties. There are a number of idle quartz mines at Grass Valley, among them the Auriferous, Aurora Mining Company, Ben Franklin Mining Company, Berriman Consolidated Mining Company, Bullion Consolidated Mining Company, Cabin Flat, California Grass Valley Mining Company, Croesus, Dakota, Daisy Hill Mining Company, Eureka Crown Mining Company (Beekman Hill Diggings), Gold Blossom, Golden State Exploration Company, Golden Star, Golden Treasure Mining Company, Goodall Consolidated and Polaris Mining Company, Hartery, Hudson, Horseshoe Mining Company, La Marque, Morehouse, Minnesota, Niagara (with a 15-stamp mill), Powning Mining Company, Standard Mining Company, Scofield, Shamrock, Slate Ledge and Perrin (New York-Grass Valley Mining Company), St. John Mining Company, Springhill, Syndicate Consolidated, South Idaho, Sunflower Mining Company, Union Hill Consolidated Mining Company, and West Point. A company has been formed by the principal owners of the Empire Mines, known as the Empire West Mines, which includes the old mines known as the Wisconsin, Omaha, Illinois, and Menlo, none of which were productive in 1907.

At Nevada City the Champion Mining Company is the largest producer. It owns about 30 locations and is being worked partly by lessees, though the company does considerable work on its own account. The mine is fully equipped with milling facilities. The Murchie Gold Mines Consolidated at this place has a 20-stamp, plate-amalgamation mill, with concentrators, and 2 canvas plants. Among other producers at Nevada City are the Bellefontaine Mining Company, Buckeye Consolidated Mining Company, Gold Flat Consolidated Mining Company, Gaston Ridge Mining Company, Horseshoe Mining Company, and Posey Consolidated Mining Company. A large number of mines at Nevada City were closed down during 1907.

Of the producing placers near Grass Valley and Nevada City, in Grass Valley district, may be named the Jenny Lind drift mine and the Posey Canyon drift mine. Most of the others are small operations.

At French Corral there is 1 deep mine producing on a small scale and 1 large gravel property, owned by the Esperance Mining Company. At Graniteville the numerous mines and mills were almost all idle in 1907, but since the close of the year the Republic Company has been running its 10-stamp mill. At Lowell Hill the Liberty Hill hydraulic mine is a large producer. The mines at Meadow Lake and Moore's Flat returned no production for the year. At North Columbia the main producer is the Consolidated St. Gothard, owned by the Champion Mining Company, of Nevada City. There is very little being done at North Bloomfield except by whites and Chinese in small placer operations. None of the large companies are making any production of moment. The famous old North Bloomfield Mining Company has gone out of existence and has been absorbed in the River Mines Company, which also now includes other noted properties, such as the Badger Hill, the Cherokee, the Kate Hayes (of North San Juan), and the Union Gravel, none of which operated in 1907. North San Juan has only a production from miners working in a small way for themselves; none of the large companies named above have been working lately. The Nevada County Mammoth Mining Company spent many thousand dollars in machinery and prospecting for copper at this place, and sunk a 400-foot shaft, with crosscuts. From Relief there was only a nominal production. At Rough and Ready the Great Ironclad Gold Mining Company is operating with a small mill, testing the ores. The company is preparing in 1908 to install a complete mining and milling plant. Some small placer work was done at this place also in 1907. At Spenceville the California Gold and Copper Company is taking out some copper ore, which is shipped to the Mammoth smelter in Shasta County. At Washington the Ethel Mining Company, having a 10-stamp mill with concentrators, is producing, but most of the work in 1907 was in installing machinery and retimbering the ground. There is a 400-foot tunnel on this property. The Waldeck mine is in 1908 building a 10-stamp mill with small 230-pound stamps. The Omega hydraulic mine at this place was also productive. There is much low-grade quartz reported in the section about Washington and Graniteville, but development is not very active, and several mines and mills are idle. At You Bet the few producing mines are small placers.

In 1907 there were a number of drawbacks to mining in Nevada County, among them the financial stringency and the two months' strike of the miners in Grass Valley. Since the close of 1907 prospects have improved materially. The newly found ore body in the Idaho–Maryland in 1908 is of considerable importance, as is the intersecting of the rich gravel channel in the Jenny Lind and the finding of a good shoot of ore in the Kenosha.

PLACER COUNTY.

Placer County in 1907 produced 23,354.10 fine ounces of gold, valued at $482,772, and 5,088 ounces of silver, valued at $3,358. Of copper it produced 17,785 pounds, valued at $3,557. The total production of the county was valued at $489,687. It is impracticable to make any comparison with the yield of 1906, for the reason that the returns of Orange and Placer counties were combined in the report of that year. Reports were received in 1907 from 89 producers, of which 15 were quartz mines. Of the 74 placers, 9 were hydraulic, 34 drift, and 31 sluicing properties. Reports were received from 116 nonproducing mines in the county.

Considering the quartz mines of Placer County, it may be said that those close around Auburn are few and worked on a small scale. At Butcher Ranch are the Gold Blossom, the North Star, and the Red Hill mines, 2 of which are "quartz seams" really worked by ground sluicing or by the hydraulic process. At Forest Hill the Three Queens mine yielded quite largely in "specimen" rock, which was crushed and the gold panned out by hand. This property is now being more fully developed. The Daniel Webster mine, at Michigan Bluff, also yielded some ore, which was worked up in a mortar. At Ophir the productive Three Stars Mining Company has a shaft 1,200 feet deep and a 20-stamp plate-amalgamation mill, with concentrators. A number of mines at this place and at Newcastle, formerly productive, showed no yield in 1907. Several of them are equipped with mills. At Towle the Rawhide Gold Quartz Mining Company is producing, and is operating a 10-stamp mill with plate amalgamation and concentrators. The Southern California Gold Mining Company (Herman mine), at Westville, which is a producer, had a 10-stamp mill running in 1907, and has since added 30 stamps. Partial installation was made of a large steam plant for the generation of electric power for the mill, hoist, compressor, and other machinery. The La Trinidad Gold Mining Company, near Cisco, has a 10-stamp mill with plate amalgamation and concentrators, and a cyanide plant was installed in 1908. The mine was closed in 1907, pending arrangements for changing the methods of saving values. The Dairy Farm copper mine, at Trent, made no output in 1907, owing to the uncertainty of smelting conditions at the proposed smelter at Point San Bruno, San Francisco Bay. The company has a 100-ton cyanide plant for oxidized ore. The sulphide ore will be shipped to a smelter when the question of smelter fumes is settled.

It is from the gravel mines that most of the gold of Placer County is obtained. The deep mines of the county yielded in 1907 $138,241, while from the placers were recovered $344,531. The 9 producing hydraulic mines yielded for the year $89,428; the 34 drift mines, $216,240; and the 31 surface or sluicing mines, $38,863. The Forest Hill Divide is the principal seat of drift mining in the county. During 1907 the gold-mining industry in that section was in a worse condition than for a number of years past. A number of properties have virtually exhausted their reserves, and the exploitation of new mines was not active, as larger returns were offered elsewhere than could be consistently expected from the gravel properties of that section. Work is now being prosecuted in the gravel mines at Todds Valley, Bath, Last Chance, and in the North Fork of the American River east of Towle. The most important mine on the Forest Hill Divide and the most completely equipped is the Hidden Treasure, at Bullion. This mine has a wide reputation as being the largest and most successfully operated low-grade drift-gravel mine in this country, and in view of this some brief description may be admissible. The Hidden Treasure mine was located in 1870, and development work was prosecuted for some years, when, after driving 2 bed-rock tunnels, auriferous gravel was struck in 1876. This property has been in continual successful operation since that time, declaring regular dividends to its shareholders during all these years. Its operations have been confined almost wholly to what is known as a white channel, a deposit of quartz gravel ranging in width from 2,500 to 3,500 feet between rims. It has been mined for a length of about 3 miles, the pay gravel running from 500 to 800 feet in width and being about 6 feet in depth. When first opened up, the gravel was extracted by cars operated by hand; eventually horses were introduced into the mine; and in 1897 the water power connected with the property was utilized and transmitted by pipe line to water wheels under a pressure of 850 feet, generating 200 horsepower, which was electrically transmitted 3 miles to the tunnel at Bullion. An underground system of electric haulage was installed, thus greatly reducing the expense of operation as well as lighting the property and operating the machine shop and a small sawmill for cutting mine timber. By this means an average of from 100,000 to 125,000 tons of gravel were extracted per year through tunnels varying in length from 1 to 2½ miles. As an historical fact, it may be stated that this was the first installation of underground electrical haulage in California, and at that time many predictions were made that the plan would prove a failure. But, on the contrary, it was an unqualified success. The number of men employed on this property has varied from 150 to 250. The formation of the gravel and bed rock is friable, and in order to support the roof large quantities of mine timber are required. The square-set system is used in breasting. As the bed rock is soft, the pressure of the overlying materials, consisting of gravel and lava cap, varying in depth from 500 to 1,000 feet, causes this rock to swell, crushing the timbers placed to support the roof. This has been one of the largest items of expense in operating the property, outside of labor. The first cost of running the main tunnel has been small as compared with the subsequent cost of maintenance due to swelling bed rock. A shaft was sunk on this property to tap the underground workings at a distance of about 2 miles from the entrance to the portal of the main tunnel, which is the deepest upon the Forest Hill Divide. This shaft was sunk for the purpose of ventilation and for the more economical handling of mine timber. It is 6 by 12 feet in section, with 2 compartments, and is 750 feet deep. A steam sawmill was erected near by, which saws all the timber required for mine uses. A 50-horsepower electric hoist is installed for the purpose of lowering timber into the mine, and an electrically driven pump raises water from the bottom of this shaft, 850 feet, to a tank above the sawmill for the generation of steam and other purposes.

At Damascus the Red Point drift mine, owned by the Societé des Mines de Golden River, continues to produce. At Forest Hill among the productive mines are the Buckeye, Devil's Canyon, Gunz, Fletcher, Hales, Lehigh Canyon, Reamer Consolidated Mines Company, and

Ross. At Michigan Bluff the main producers are the Home Ticket drift and the Placer Gravel Gold Mining Company (drift). Others there are the Bigelow, Bird, Bald Mountain, and Morning Star. The Haub drift mine at Blue Canyon produced during the year, and the Lost Camp drift mine at the same place was operated by the hydraulic process. At Colfax the productive mines were all small ones. There was quite a production from small operators around Dutch Flat. At Gold Run the Gold Run Gravels Company (Limited) has been superseded by the United Water and Power Company of California, which made a considerable yield by drifting the property. The Gold Run Placer Company hydraulicked the bench gravel of the Druid claim, and the Indian Hill was also worked by the hydraulic process. The Indian Bar and Pacific and the Rocky Point are both productive hydraulic mines. There are many small drift and sluice mines also in the vicinity of Gold Run. Among the prominent producing drift mines at Iowa Hill are the Big Dipper, Booth River, Gleason, Gould, and Indian Canyon. The McGeachin Placer Gold Mining Company now operates the drift mine formerly owned by the Jupiter Consolidated Mining Company. Both at Lincoln and at Loomis are a few small placers, and there are also a few at Towle and at Weimer. A number of the larger gravel mines in Placer County show a considerably reduced yield in 1907 from that of 1906, and the instances of increase are quite few.

PLUMAS COUNTY.

The metallic production of Plumas County in 1907 was 10,611.29 fine ounces of gold, valued at $219,355, and 1,436 ounces of silver, valued at $948, a total of $220,303, which is a decrease from the figures of 1906 of $10,102. There were 80 producing mines which reported for the year, of which 12 were deep quartz mines and 68 were placers. Of the latter 26 were hydraulic, 6 drift, and 36 surface placers. There were 78 producing mines in 1906. The 12 quartz mines reported a tonnage of 23,907 in 1907, as compared with 21,040 tons in 1906. The quartz mines reporting this tonnage yielded a total of $90,890 in gold and $329 in silver. The only important quartz mine now productive in the county is that owned by the Jamieson Mining Company at Johnsville, which has a 20-stamp plate-amalgamation mill, without concentrators. The vertical shaft in the mine is only 151 feet deep, but there is a crosscut tunnel 1,500 feet in length and a drift on the ledge of 1,500 feet. The output in 1907 was somewhat curtailed by shortage of water for motive power. The Johnson Graham Mining Company, operating the old Plumas-Eureka mine at Johnsville, made a small production, but the ore milled was only that taken out in the course of "dead work" development. The mine is equipped with a 20-stamp mill and concentrators. None of the other quartz mines of the county, of which there are several with mills, made any output of moment in 1907. As to gravel mines, almost without exception the placer mining operations were small in extent. Among the more prominent producers are the Empire placer at Quincy, the Smith's Bar at Spanish Ranch, and the Alturas Tailings claim at La Porte, the latter worked by Chinese lessees. Gravel mines are being worked at Beckwith, Buck, Clio, Crescent Mills, Cromberg, Eclipse, Genessee, Johnsville, La Porte, Longville, Nelson Point, Prattville, Quincy, Seneca, Spanish Ranch, and Taylorsville. On the Caldwell group of quartz mines at Brush Creek, where there is an 8-stamp mill, considerable development work was in progress in 1907, but there was no output. The Morning Star and Trenton Mill and Mining Company at the same place, which has a 20-stamp plate-amalgamation mill and a reverberatory furnace, did no work until June, 1908. The operators of the Little California mine at Buck crushed no ore in their 5-stamp mill in 1907. The Crescent Mills Mining and Milling Company, operating a well-developed mine equipped with a 32-stamp mill, shut down in 1907 owing to the death of the owner, but will resume work in 1908. The Long Valley Mines Company at Quincy, with a 9-stamp mill and concentrators, has had its mill remodeled, and started up again in July, 1908. The Plumas-Mohawk Mining Company at Johnsville has 4 Huntington mills, which were not started up until May, 1908. The ore bodies in the mine are reported to be large but of low grade. The Bluff City Mining and Development Company will probably have a mill in 1908. The Plumas mine, at Quincy, had its dam destroyed and its pipe lines and machinery buried by a cloud-burst in March, 1907. At Taylorsville a number of mines are under development for copper, but there have been no shipments. At Genessee a great deal of development work has been done on the copper properties, but on account of distance to the smelters the miners are obliged to wait for the completion of the Western Pacific Railroad before any ore can be shipped. Considerable ore is piled up waiting for the railroad to be finished.

SACRAMENTO COUNTY.

In 1907 Sacramento County produced 38,263.32 fine ounces of gold, valued at $790,973, and 3,082 ounces of silver, valued at $2,034, a total of $793,007, which is $197,257 less than the total product in 1906. There were in 1907 only 12 productive mining operations carried on in the county, all placer, of which 3 were surface sluicing mines, 2 drift, and 7 dredges. By far the larger proportion of the gold came from the dredging operations near Folsom, and since the close of the year five new dredges of large capacity have been put at work in this field. There were 3 dredging companies operating in the Folsom field in 1907, 1 with several dredges, and in 1908 the Natoma Dredging Company installed dredges which are in active operation.

The largest production in the county outside of the dredges was by the Blue Ravine Mining Company, which operates a drift property at Blue Ravine, above Folsom. The Willow Spring Hill is a productive mine, in which gravel is worked by ground sluicing. Some platinum is found with the gold.

The most important gold producer in the county was the Folsom Development Company, which operated 5 dredges in 1907 and has since built another one. The Ashburton Mining Company and the El Dorado Gold Dredging Company also both operated dredges in the Folsom field in 1907.

The Folsom dredging field has 2 distinct workable channels. One channel is a clean "wash," easy to dredge and treat, as there is no clay and little sand. The other channel is doubtless the most difficult to mine ever tried by this system. It averages from 60 to 75 feet in depth, the first 6 or 8 feet being cemented, and it continues very compact for 25 to 30 feet; the lower portion of the gravel bed is looser and presents no difficulties. In working this channel the upper portion is hydraulicked by water thrown through nozzles under pressure. At first 2½-inch nozzles were used, but the water cut under the bank and caved it back on the buckets of the dredge, causing damage. Now, nozzles of 4-inch diameter are being put in and the gravel is being hydraulicked off in benches. For this work a 100-horsepower motor and a 10-inch pump are used, and the water for the nozzles is pumped from the pond in which the dredge floats. Two monitors are used on each boat, one on each side of the well hole, and these are operated at the same time for about two-thirds of the working hours. The dredges working by this system in the hard ground have buckets of a capacity of 8½ cubic feet each. The newer machines in this field have a double bank of gold-saving tables and a system of double tail sluices. The double bank of tables is designed to get more gold-saving area in one boat. In these machines the sand pump is dispensed with. Gravel difficult to wash is effectively handled by the use of the revolving screen. Great advantage has been gained by the use of special steels in the most used parts of the new dredges. The bucket line, the most expensive part of a dredge and the most exposed to wear, has been so improved by the introduction of chrome steel, nickel steel, and other special steels that even in the hardest digging the bucket bottoms will last for two and a half years. The recent development in building dredges in this and the Marysville field has demonstrated that ground which a few years ago could not be dredged can now be handled with profit.

SAN BERNARDINO COUNTY.

San Bernardino County in 1907 produced 7,675.95 fine ounces of gold, valued at $158,676; the production of silver was 123,241 ounces, valued at $81,339; of copper 590,649 pounds, valued at $118,130, and of lead 9,020 pounds, valued at $478—a total value of $358,623. This is $130,929 less in value than the county yielded in 1906. The falling off in gold was $196,154; the increase in silver was $47,574; the increase in copper was $18,923, and the increase in lead was $1,272. The decrease in output may be attributed entirely to the cessation of operations on the properties of the Bagdad-Chase Mining Company, which did not operate its mines in 1907. The plant at Barstow consists of a 50-stamp mill equipped for the cyanide process. Mill operations at Barstow in 1907 were altogether upon the tailings accumulated there from amalgamation of the Bagdad-Chase mine ores at Camp Robertson or Stagg P. O. There were 26 deep mines operated in the county in 1907 and 1 placer. Of the deep mines, 11 had gold as the predominating metal, 6 silver, 1 gold and silver, 6 copper, 1 lead, and 1 copper and lead. Of nonproductive mines, 48 reported. There were 20,537 tons of siliceous ore worked in the county in 1907, and 5,579 tons of copper ore; of lead ore there were only a few tons, and of copper-lead ores 40 tons, the total being 26,158 tons. The Roosevelt Mining Company, of Stedman, is a an important producer and ships its ores to the Peyton Chemical Company, of San Francisco. At Victorville there are a few small producers. The Sidewinder mine at that place has its concentrates treated at the smelter at Needles. The output is almost entirely gold. At Daggett, D. W. Earl & Co. are producing silver ore which is shipped to smelters for reduction. Other small producers at the same place are doing this likewise. North of Cima the Cocopah Copper Company, working the Copper World mine, is a large producer, and ships the ore to the smelter at Needles. Also at Cima the properties of the Death Valley-Arcalvada Consolidated Mines Company are producers of silver, and a concentrating plant is being erected in 1908. The Brooklyn Mining Company, at Cima, has a small mill with concentrators. The Seal of Gold Mining Company is operating the Supply mine, at Dale, but, though productive, it was doing mainly development work in 1907. The 6-stamp mill is out of date. The O. K. mine, formerly belonging to that company, is now owned by H. H. Landwehr, and is equipped with a 10-stamp mill and a 50-ton cyanide plant. At Fenner the Bonanza King Development Company has a 10-stamp mill, with concentrators and pans and settlers. At Barnwell (formerly Manvel) the Sagamore Mining Company, working the old New York mine, made a small output, and completed early in 1908 a 50-ton roller concentrating mill. Test shipments were made from the Alpha mines Nos. 1, 2, and 5. The Ivanpah Mammoth Gold and Copper Company shipped ores in 1907 for test only. All the properties reporting output from Needles were small ones. Hart district, 9 miles east of Barnwell, near the Nevada line, will have some production in 1908. The Jumbo claims are reported to be very promising. Hart & Hitt are also active operators on the Oro No. 1 and No. 2 claims, adjoining the Jumbo claim. In Calico district little or nothing was done in 1907, but a small custom mill has been put up. Among the nonproducers reporting, the Daggett Lead Mining Company has an idle 50-ton concentrator. The Garavanza Mining and Milling Company has a large mill and concentration plant. The Silver King, at Cima, will probably produce in 1908. The Virginia Dale Mining Company's mill at Dale was ready for operation in April, 1908. The Providence Gold and Copper Company, of Kelso, has 2,000 feet of tunnels and numerous small shafts. Considerable development work was done in 1907. The Colosseum Mining Company, at Ivanpah, confined itself to development work in 1907. In 1908 a new district was organized, known as Kewanee, in the Kessler range, 7 miles from Cima on the Salt Lake Railroad, and 6 miles from Ivanpah on the Santa Fe branch line. The veins found are not large, but the ore is reported as of high grade.

SHASTA COUNTY.

Metallic production of Shasta County, Cal., in 1906-1907.

Year.	Gold.		Silver.		Copper.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		
1906	39,626.09	$819,144	648,482	$434,483	22,477,304	$4,338,121	$5,591,748
1907	38,312.85	791,997	560,926	370,211	23,457,417	4,691,483	5,853,691
Increase (+) or decrease (−)	−1,313.24	−27,147	−87,556	−64,272	+980,113	+353,362	+261,943

This table was compiled from returns received from 35 producing mines in Shasta County in 1907, of which 27 were deep mines, 23 of these being gold and 4 copper mines. There is one productive dredge in the county and 7 surface placers. Reports were received from 119 unproductive mines, on a number of which, however, development work is being carried on.

From this table it appears that while there was a decrease in both gold and silver output for the year 1907, as compared with 1906, the increase in the copper values more than offsets this loss, so that the county showed a total increase for the year of $261,943. The grand total of $5,853,691 is the highest yield ever made by Shasta County, with the exception of the year 1901, when the total was $6,737,571. The total for the year shows that Shasta continues to be the leading county of the State in metallic production. It stands first in copper output, first in silver output, and eighth in gold yield in the rank of the counties of the State.

With the exception of Amador County, Shasta shows the largest ore tonnage in the State, the output in 1907 having been 342,856 tons. Of this, 54,278 tons were siliceous ore and 288,578 tons were copper ores. The latter yielded 23,457,417 pounds of copper, valued at $4,691,483. The yield of gold from the 54,278 tons of siliceous ore was 23,985.92 ounces, valued at $495,833. The gold yield from the copper ores was 13,208.02 fine ounces, valued at $273,034. The siliceous ore yielded in silver 42,465 ounces, valued at $28,027, and from the copper ores were obtained 518,291 ounces of silver, valued at $342,072. More or less of both the gold and silver credited to copper ore in this county was actually derived from the siliceous ore used as a flux in smelting the copper ore. An accurate segregation of these ores is difficult.

The production of silver in the county was curtailed during the year 1907, mainly because of the shutting down of the De La Mar Smelter, which had been treating the copper ores of the Bully Hill mines, which contain more silver than those of the western part of the county.

Copper mining in Shasta County appears to have a very bright future, and with the present smelter capacity in full operation the production of copper will reach much higher figures than at present.

The year 1907 witnessed the greatest progress that has so far been recorded in the mining operations of Shasta County, particularly in the copper mines on the Shasta County sulphide ore belt, comprising the Iron Mountain, the Little Backbone, the Bully Hill, and the Afterthought districts.

Iron Mountain district.—During several months of the year the Mountain Copper Company operated 2 of its furnaces at the Keswick plant in Shasta County, in addition to its smelting plant located near Martinez, in Contra Costa County. Late in the year the Keswick smelter was again shut down. The electric road connecting the Hornet mine with the Iron Mountain Railroad was completed, and shipment from that property was begun. It is reported that developments during the year greatly increased the known ore reserves of this mine.

The Balaklala Consolidated Copper Company devoted its energies to getting ready for large operations and has practically completed at Coram, a new station on the line of the Southern Pacific Railroad about 12 miles north of Redding, the largest smelting plant on the Shasta County copper belt. The plant, completed in 1908, consists of a 1,250-ton smelter with roasters, reverberatories, and Clark furnaces, but no converters. Extensive development was continued at the mine, and the surface installation and equipment on the property was an important factor in the added equipment in Shasta County for the year. The mine and smelter have been connected by an aerial tramway capable of delivering 100 tons of ore per hour. The Shasta King mine of the Trinity Copper Company, immediately adjoining the Balaklala, was connected with the mine terminal of the tramway of the latter property with a view of shipping its ore for reduction to the Coram smelter.

Development work was carried on during the year at the Sugar Loaf mines, adjoining the Hornet properties of the Mountain Copper Company, and at the Spread Eagle mines adjoining the Balaklala group.

Little Backbone district.—The Mammoth Copper Mining Company—a subsidiary company of the United States Smelting, Refining, and Mining Company—was the largest producer of copper on the Shasta County belt during the year 1907, and bids fair to remain so for some time to come. The large modern smelting equipment at Kennett was increased by the addition of 2 new furnaces, and a converter plant was also installed. The new equipment was so far advanced by the end of the year 1907 that the increase of production for the year 1908 will doubtless be much greater than in 1907. In addition to the added smelter equipment the company constructed between 4 and 5 miles of narrow-gage railroad into the siliceous ore district at Old Diggings and Quartz Hill, located about 5 or 6 miles north of Redding. This construction places the Mammoth Company in an especially advantageous position so far as securing siliceous ore for the smelting of the basic ore produced by the Mammoth mine is concerned. The haulage system between the Mammoth mine and the smelter was also materially improved by the construction of a standard-gage railroad up Little Backbone Creek. This is connected by a gravity tram with an electric haulage system higher up the mountain from the mine to the upper terminal of the gravity tram. This system is to replace the aerial tram previously in use. The Mammoth mine is developed through tunnels 2,700 feet long in the aggregate. The capacity of the smelter is 1,000 tons daily. The low-grade matte is shipped to the United States Smelting Company's smelter at West Jordan, Utah. Considerable ore from this mine was also shipped to the Peyton Chemical Company on upper San Francisco Bay.

The Golinsky mines near Kennett were operated under an option in 1907 and shipped sulphide ores to the smelter at Garfield, Utah. Considerable development work was done on the Summit mines, adjoining the Mammoth, by the Stauffer Chemical Company.

Bully Hill district.—The Bully Hill Copper Mining and Smelting Company carried on very extensive improvements at Bully Hill, and during the year improved the mine equipment by the installation of 2 electric hoists—one in the Bully Hill mine main shaft, and the other in the Rising Star. The Bully Hill shaft was enlarged to 3 compartments, and the mine has been opened to the 970-foot level. The Rising Star shaft was also enlarged to a 3-compartment shaft, carried through to the surface, and has attained a total depth of 800 feet. Large reserves of ore have been opened up on Bully Hill in both of these shafts.

The smelting equipment at De La Mar, immediately adjoining the Bully Hill mine, has been entirely reconstructed and will have a capacity when the present plans have been fully carried out of about 800 tons of ore in 24 hours. In addition to the construction of a new blast furnace, a reverberatory furnace is under construction for handling the fines and the flue dust, and fuel oil will be used in operating this furnace.

A subsidiary company, the Sacramento Valley and Eastern Railroad, had under way construction of a standard-gage line from Pit, at the mouth of Pit River, on the line of the Southern Pacific Railroad, to De La Mar, a distance of about 17 miles. This road was completed early in 1908, after which the first furnace installed was blown in, and the reduction of Bully Hill ores was resumed after about two years of inactivity. The Bully Hill mines will doubtless continue a very important factor in the copper output of Shasta County for many years.

Afterthought district.—About 7 miles southeast from Bully Hill, the Afterthought mine of the Great Western Gold Company is located, and this property during the year 1907 very materially increased its production over that of 1906. Development at depth on the vein is reported to have demonstrated the existence of ore fully 300 feet below the older workings of the mine.

A railroad is projected between the Great Western Gold Company's smelter at Ingot, and the nearest railroad point at Bella Vista.

Old Diggings and Quartz Hill districts.—The construction of the narrow-gage railway into these districts by the Mammoth Copper Company has greatly facilitated the shipping of ore. The original Quartz Hill mines, at Buckeye, are being operated by the Mammoth Copper Company. In the Old Diggings district the Evening Star mine and the Reid and Handy group are important producers.

French Gulch district.—The chief mining district of Shasta County, in the vicinity of French Gulch, had a good average output for the year. The Gladstone mine was developed to greater depth and assisted materially in keeping up the output from this camp. The mine is equipped with a 20-stamp mill and 8 concentrators. The Brunswick mine, quite an important producer, is equipped with a 10-stamp mill and vanners, and is under individual ownership. The Milkmaid mine, quite a large producer, has a 10-stamp mill with plate amalgamation, but did not use it in 1907, having shipped its ore to the Mammoth Copper Company's smelter. The ore mined was from the Franklin claim of the Milkmaid group. The Black Tom Gold Mines Company, working the Niagara mine in 1907, demolished the old mill and in 1908 erected a 10-stamp mill with concentrators. The Washington mine turned out considerable bullion during the year. Other small mines in this district made some production.

Harrison Gulch district.—In the Harrison Gulch district, of southwestern Shasta, the operators of the Midas mine succeeded in recovering its pay shoot at considerable depth on the east side of Harrison Gulch after passing through an extensive fault. By the end of the year this property was again in shape to keep in operation its full complement of stamps. The property is equipped with a 20-stamp mill and a 50-ton cyanide plant. The company works its own concentrators and tailings.

Other districts.—From the Crown Deep, at Shasta, no ore was shipped in 1907, but development work was continued. The Tarantula, at Taylor, has a 10-stamp mill, and expects to keep it running in 1908. Only development work was done at the Sybil mine in 1907. The Great Falls, Hope, and Manzanita mines, at Igo, which have a small Tustin mill, will probably be worked more vigorously in 1908 than in 1907. The Mad Ox and Stella mines, at Stella, are making a small output. Among the nonproducers, the Delta, at Bayles, is under development and expects to construct a tramway and to ship ore to the smelters along the copper belt. The Boulder, at Castella, is also under development. At Gas Point there is a placer output obtained by rockers.

SIERRA COUNTY.

Sierra County produced in 1907 in gold 23,408.86 fine ounces, valued at $483,904, and in silver 3,971 ounces, valued at $2,621, a total of $486,525. In 1906 the output was 19,803,08 ounces of gold, valued at $409,366, and 3,759 ounces of silver, valued at $2,518, or a total of $411,884. The increase for the year 1907 as compared with 1906 is therefore $74,641. Reports were received from 52 producing mines, of which 12 were deep gold mines and 40 placers. Of the latter 14 were hydraulic, 18 drift, and 8 surface mines. The quartz mines produced 56,625 tons of siliceous ore in 1907, yielding $389,601 in gold and $2,246 in silver, a total of $391,847. The hydraulic mines of the county yielded $42,749 in gold; the drift mines, $48,551; and the placers, $3,003—a total of $94,303. The total silver derived from placers was valued at $375. It may be noted from these figures that though Sierra is usually considered particularly a gravel-mine county, yet the larger part of the gold and silver yield is derived from quartz properties. The quartz mines of the county increased the value of their yield in 1907 over that of 1906 by $99,024. The principal quartz mines are at Alleghany and Sierra City. The largest producer at Alleghany is the Croesus Mining Company, which is developed by tunnels, respectively, 3,863 feet, 2,565 feet, 2,318 feet, and 1,661 feet in length. The treatment plant consists of a 20-stamp mill (plate amalgamation), with concentrators. The next mine in importance at this place is the Tightner, which has no treatment plant, but has been yielding exceptionally high-grade ore in both 1907 and 1908, particularly in the latter year. Very few men are employed at the mine. The pay streak is small, but carries numerous very rich pockets. A crosscut tunnel to intersect the Tightner ledge at a depth of 700 feet is being run. At Downieville the Alice Mining Company has a 5-stamp mill. The Alaska mine, at Pike City, has a 20-stamp mill, with concentrators. The vertical shaft is 350 feet deep, and there is a drain tunnel 1,800 feet long. The mine was closed part of the year while a power line was being constructed. The Alta Sierra Mining Company, at Sierra City, operating the Keystone mine, has a 10-stamp mill, with plate amalgamation but no concentrators. The mine was idle during part of the year, a snowslide having damaged much of its plant. The tunnel on this mine is $1\frac{1}{8}$ miles long. The King Consolidated mine, also at Sierra City, only ran one month in 1907, but the grade of ore extracted and milled was exceptionally high. The Sierra Buttes property, at the same place, a reopened mine, has 9 tunnels upon it, which are from 600 feet to 2 miles in length. It is equipped with a 60-stamp, plate-amalgamation mill and a 300-ton cyanide plant. Of the 60 stamps 40 are in one mill and 20 in another. In 1907, 20 stamps were run for 6 months, 40 stamps for 3 months, and 60 stamps for 3 months. There are no other producing quartz mines in the county of especial importance.

Of the placer mines, the Alleghany Mining Company, at Alleghany, works its claim partly by drifting and partly by hydraulic process. The Golden Star at that place is a drift mine. The Depot Hill mine, not far from Camptonville, Yuba County, is the most productive hydraulic mine in Sierra County. At Downieville are a number of productive gravel mines, but they are all small producers. Of the mines at Forest the same thing may be said, the very large mines formerly operated at that place having ceased to be productive. Several quartz mines are being developed near Forest, and some new drift mines are being opened. At Gibsonville the largest producers are the Bellevue Mining Company, a drift mine, and the North America Consolidated Gold Mining Company, which is worked by the hydraulic process. Several small gravel mines at Pike are being worked by whites and Chinese. At Port Wine, Scales, Sierra City, and Sierraville a number of small placers are worked. The Clipper Ship drift mine, at St. Louis, is the largest producer at that place. At Table Rock are a few placers which are producing small amounts. The development of the rich ore at Alleghany has turned attention again to the possibilities of quartz mining in other places, especially at Sierra City. Quite a number of the old mines there and at other points are being reopened by new interests. The prospects of the county are brighter than for several years past.

SISKIYOU COUNTY.

Siskiyou County in 1907 produced 19,254.07 fine ounces of gold, valued at $398,017, and 4,602 ounces of silver, valued at $3,037, a total of $401,054. It is not practicable to make an exact comparison with the yield of the county in 1906, since in the report of that year its figures were combined with those of Stanislaus County in order to conceal the output of the single quartz mine in the latter county, but there is a material decrease apparent. Siskiyou has the largest number of productive mines of all the counties in the State, the total being 143, of which 36 are deep quartz mines. Of the 107 productive placers, 66 are hydraulic, 4 drift, and 37 surface placers. There are more hydraulic mines now being worked in Siskiyou than in any other county in California, there being no legal restrictions there as to impounding or otherwise caring for the débris. There are no navigable streams in the county. The ore mined was entirely siliceous ore, and amounted in 1907 to 15,390 tons of ore, which yielded $181,014 in gold and $1,675 in silver. The output from the placers of various kinds was valued at $217,003 in gold and $1,362 in silver, a total of $218,365. Formerly the gravel mines of Siskiyou exceeded in value of annual output that of all other gravel mines in California, but now the gold yield from that source is exceeded in the counties of Butte, Yuba, Sacramento, Placer, and Trinity. There were 41 fewer mines producing in Siskiyou County than in 1906, and 190 mines reported "no production."

Of the producing deep mines of Siskiyou County the Black Bear is an old one, and has lately been taken over by a new company, which is developing it. At Callahan both the Helena Gold Mining Company and the McFadden made comparatively small outputs in 1907. At Cecilville the Advance Gold Mining Company has a 5-stamp mill and concentrator. At Etna Mills the Highland has a small mill and concentrator; there was only a small output, as time was mainly occupied in driving tunnel No. 3. The Taylor Lake, with a small mill, and the Homestake Mining Company, at Etna Mills, both made a small output, as did the Czarina Mining Company, which has a 5-stamp, plate-amalgamating mill and concentrators. The Denure and Burton, at Fort Jones, with a 2-stamp mill, made an important output. The Golden Eagle Mining Company has a 3-stamp mill, and the Patterson Creek Mining Company a 10-stamp mill, both at Fort Jones. The Squaw Creek Mining Company (Dewey mine), at Gazelle, made some shipments early in 1907 and then closed down. The only productive quartz mine at Gilta was the Consolidated Gold Run. The Morrison-Carlock Mining Company, at Greenview, a large producer, has a 10-stamp mill. At Hawkinsville the Elk Creek Mining Company and the Aggie are producing, the latter shipping sorted ore to the smelter. At Henley the Indian Girl and the Arnett are worked. The China Gulch and Moon & Lowe are two producers at Hornbrook. There is only one quartz mine reported from Nolton—the Iron Stain mine. The few mines at Rollin made a small output. The Holman Toskett Mines Company, at Sawyers Bar, is developing the Jumbo mine. The mill has 20-stamps, with plate amalgamation. At the same place other quartz producers are the Blue Light and Hoodo, the Oregonian group, and the Gold Hill mines. At Scott Bar the Wedge mine is being operated in a small way. The Schroder mine, at Yreka, will probably operate on a larger scale in 1908. The Mono Mining Company is working the Punch Creek mine, and has a 5-stamp mill, with concentrators and a cyanide plant. This is the most productive quartz mine in the county.

Of the placer mines in Siskiyou County, though they are numerous, there are none which are exceptionally large producers. Indeed, the property of the Quartz Valley Mining Company, at Greenview, a hydraulic mine, is the only gravel mine in Siskiyou County which yielded over $10,000 in 1907. Near Black Bear are a few white and Chinese placer miners. At Callahan are the Johnson, Negley, Welker, and Walker & Fippen mines. At the latter decomposed quartz is being worked by the hydraulic process. The productive mines at Cecilville are the Burgess, Banner Mining Company, Malheur Creek drift, Morning Star, Orton Gulch, Salmon River Hydraulic and Ditch Company, and Excelsior. At Forks of Salmon the mines are all hydraulic and are important producers. These are the Bloomer, Crapo, Horn Bar, Knudson, the claims of the Nordheimer Mining Company, Picayune, and Sauerkraut. Near Fort Jones the gravel mines are small ones. The Parrott hydraulic mine is the only producer at Gazelle. At Greenview are the Chase and the mines of the Quartz Valley Mining Company. The Happy Home, Kuntz Flat, Milne, and Slough mines are being worked at Hamburg. At Happy Camp the producers are the Busse, Carter, China Creek, Classic Hill, Maddox & Lewis, Nolan Bar, Pennsylvania, Toothache Hill, and a number of mines operated by Chinese. There are no large producers at Hawkinsville, those operated being the Big Joe, Leal, the mines of the Miller Placer Mining Company, the Long Gulch, Post, Rabbit, Sylvester & Greenwood, Rogers, Soares & Company, Rocky Gulch, the mines of the Spangler Mining Company, and the Thomas and Last Chance mines. The producing gravel mines at Sawyers Bar are the Enos, Hamlin, Klein, Mohr, Sciaroni, Tonkin, Skillen, and Wilson, with a few others, and with numerous mines operated by Chinese. The Gearhart, Horse Creek, Lange, Pine Grove, and Siskiyou and Klondike mines are being operated productively at Oak Bar. At Scott Bar are the Andrews, Enterprise, Jacob, Rocky Point, Poorman's Bar, and Whiting Hill mines, as well as a number of Chinese claims. The Mississippi mine and the mines of the Pacific Mines Company are operating at Seiad. At Somes Bar are the Hayward and Runnels Creek, Oak Flat, and Ten Eyck mines. The mines at Walker are the Blarney & Crary and Jensen mines. At Yreka are some important producers, notably the Arvilla, Simas, and Sunshine, all hydraulic claims. There are numbers of Portuguese and Chinese miners in that vicinity.

TRINITY COUNTY.

In 1907 Trinity County produced 25,895.91 ounces of gold, valued at $535,316, and 3,635 ounces of silver, valued at $2,399, a total of $537,715. This is $26,119 less than the yield of the county in 1906. There were 19 quartz mines producing in the county in 1907, and their output was 25,148 tons of ore, which yielded $180,120 in gold and $839 in silver. Fifty-two placers produced in 1907, of which 37 were hydraulic, 3 drift, and 12 surface. Their combined yield was $355,196 in gold and $1,560 in silver. Trinity is the leading hydraulic-mining county of the State in point of annual output, its 37 mines of this character having yielded in 1907 $335,322 in gold. [Siskiyou County had 66 hydraulic mines but there are no very large operations, their combined yield in 1907 having been $181,458 in gold.] The largest hydraulic mine in the State is that of the La Grange Mining Company, near Weaverville, which produced in 1907 about half the entire output from this class of mines in Trinity County. The water is delivered to the banks through the giants at this mine under a 480-foot head. To secure the large amount of water needed to hydraulic on a large scale, the ditch, flume, tunnel, and pipe line extend from Oregon Mountain to Stewarts Fork, a distance of 29 miles. One of the tunnels on this line of ditch is 8,940 feet long, and one of the flumes 9½ miles long. The inverted siphon pipe crossing Stewarts Fork has a depression of 1,100 feet at its lowest point.

The total tonnage of the county, all from siliceous ore, was 25,148, which is an increase of 15,887 tons over the tonnage in 1906. The silver yield from this source fell off somewhat, but the gold yield increased $32,956. The most productive quartz mine in the county is that of the Bonanza King Mining Company, at Trinity Center. The 40-stamp mill of this mine was not completed until May, 1907, and was closed, as was the mine, during the winter months. The ore yields values of from $4 to $5 per ton. The Bear Tooth quartz mine is at Burnt Ranch, and the Golden Jubilee Mining Company and the Oro Grande are at Carrville. There are small quartz properties at both Coleridge and Coffee. The Brown Bear Mining Company, at Deadwood, is a large producer and bids fair to be still larger, as important discoveries were reported in the China tunnel since the close of 1907. The company works on its own account and also has several lessees on the property. There is a 10-stamp plate-amalgamation mill, with concentrators. The Goodyear & Richards mine at the same place has a 2-stamp mill. The Globe is the only producer of note at Dedrick and much development work was accomplished during the year, so that a large yield is hoped for in 1908. There is a 5-stamp mill on the property, without concentrators. The Bobs Farm Mining Company is working the Mountain Boomer mine, at Denny, and has a 3-stamp mill and a Huntington mill, with concentrators. At Dorleska the Dorleska Mining Company leased a portion of the property in 1907. This mine is developed by a shaft 350 feet deep and a 1,300-foot tunnel. The plant consists of a 10-stamp mill and a Huntington mill, with concentrators. The Gold Bug and Klondike group and the May group are also at Dorleska, and considerable development work was done on them in 1907. There is a 5-stamp mill on the property. The Bullychoop Gold Mining Company, in Indian Creek district, on the border of Shasta County, is a fully developed mine having long drifts on all the levels down to 700 feet in depth. There is a 30-stamp plate-amalgamation mill, without concentrators. The Texas Jack and the White Cloud quartz mines are both at Douglas City, and the Five Pines and the Surprise properties are at Trinity Center.

The gravel mines of the county are worked at many places, not being confined to any one locality. At Big Bar the Antone Point and Sandy Bar mines are small operations. At Burnt Ranch the Upton hydraulic is the largest mine, from which, in addition to the gold, 4 ounces of platinum were obtained during the year. At Carrville, Coffee, Coleridge, Dedrick, and Denny, a number of small gravel mines are operated by both whites and Chinese. The Indian Creek hydraulic mine at Douglas City is an important producer, as is the Steiner's Flat. The Union Hill hydraulic, at the same place, a producer, is being opened up. The Big Creek Mining Company, at Hayfork, extracted 5 ounces of platinum with its gold. The Bayles, King, and Williamson mines are at Helena. The largest producer at Junction City is the Chapman & Fisher hydraulic, and the Post hydraulic, at the same place, is also an important producer. Among others near these are the Cumming, Dolly Varden, Dannenbrink, Franklin & Haas, Gold Dollar, and Last Chance mines, and those of the Valdor Gold Mining Company. The Jacob mine, owned by John Jacob, obtained 180 crude ounces of platinum in its workings while hydraulicking. The Eastman Gulch hydraulic at Lewiston, operated by Chinese, is an important producer. The Minersville hydraulic mine (Beaudry), at Minersville, is one of the large producers of the county, and others at that point are the Butler Mining Company (Unity) and the Cement and Mule Creek claims. At Trinity Center the Sykes Mining Company and the Snow Gulch, both hydraulic mines, are the leading producers. Around Weaverville, aside from the La Grange Mining Company already mentioned, the Hupp group are large producers, and yield is also derived from the Ellerbrook, Lucky Strike, Meckel Brothers, Potillo, and many small mines worked by whites and Chinese.

TUOLUMNE COUNTY.

Metallic production of Tuolumne County, Cal., in 1906 and 1907.

Year.	Gold.		Silver.		Lead.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		
1906	50,294.28	$1,039,675	12,651	$8,476			$1,048,151
1907	39,032.63	806,876	9,778	6,453	6,000	$318	813,647
Increase (+) or decrease (−)	−11,201.65	−232,799	−2,873	−2,023	+6,000	+318	−234,504

The falling off in output for 1907, as shown in this table, is in both gold and silver, and is due to the smaller tonnage worked in 1907 as compared with that of 1906. The number of tons of siliceous ore treated in 1907 was 194,209, as compared with 278,618 tons in 1906, a decrease of 84,409 tons. There were 40 properties which sent in returns from Tuolumne County in 1907, of which 35 were deep mines and 5 were placers, 2 of the latter of which were drift mines, 2 sluicing mines, and 1 a hydraulic mine. These 5 placers yielded only $2,583 in gold and $13 in silver. The 194,209 tons of siliceous ore yielded 38,907.67 ounces of gold, valued at $804,293, and 9,758 ounces of silver, valued at $6,440, a total of $810,733. The average recovered value in gold and silver of the ore treated was therefore $4.17 per ton. Tuolumne is one of the Mother Lode counties of the State where the veins are quite wide and the grade of the ores low as compared, for instance, with such as are mined in Nevada County with comparatively narrow veins. Some of the pocket mines in Tuolumne County, notably those near Sonora and Tuttletown, yield " pockets " of phenomenally rich ore, but such ore is not continuous in its values as is that from the wide veins of the Mother Lode on the main belt and the east belt, from which most of the gold of the county is annually derived.

Considering the productive quartz mines of the county in 1907 in accordance with their location by post-office, the first is the mine of the Big Casino Mining Company, of Big Oak Flat, which is developed by a 400-foot incline shaft. The reduction works consist of a 20-stamp mill with plate amalgamation and concentrators. The Longfellow Consolidated Gold Mining Company, at the same place, made a comparatively small production in 1907 because of delays in building, during which more stamps were added to the mill and both mine and mill were converted to electrical equipment. The Nonpareil Gold Syndicate (Limited), at Big Oak Flat, did not begin operations until the end of 1907, and but little ore was produced. The mine is equipped with a 10-stamp plate-amalgamation mill and concentrators. The Ophir, a pocket mine developed by tunnels and a small shaft, found no pockets of much value in 1907. The Shibo, at Blanchard, has a small mill with concentrators. At Tuolumne (formerly Carters P. O.) the Duffield mine is being developed preparatory to putting up a mill in 1908. The Spring Gulch mine has a 625-foot shaft and a 4-stamp mill. Most of the work in 1907 was of a development character. The Mohican Mining Company, which has a vertical shaft 500 feet deep to the main working tunnel and about 2,500 feet of tunnels, was only in operation three and one-half months in 1907. There is a 5-stamp plate-amalgamation mill on the property. The Eagle-Shawmut Mining Company, at Shawmut, operates one of the largest mines in the county, which is developed with a 1,850-foot incline shaft and a winze 600 feet deep. The plant consists of a 100-stamp mill, with plate amalgamation and concentration. There is also a 25-ton chlorination plant, so that the ore, sulphurets, etc., are all treated at the mine. Some very rich developments have been reported on the 400 level of the mine since the close of 1907. No large producers are working at Columbia. The property of the Confidence Mines Company, at Confidence, is developed by a shaft 810 feet deep on the incline. The mill has 20 stamps, with 7 belt concentrators. The Ellen Winton Mining Company, at Groveland, has a tunnel 400 feet long and a 150-foot vertical shaft. The mill has 5 stamps, with plate amalgamation and concentrators. The Harvard mines, at Jamestown, have a 60-stamp mill, but were operated for only thirty days in 1907. The mine is developed by 2 shafts, 900 and 700 feet deep, respectively.

The persistent refusal of information by an owner of important mines throws doubt on the exact rank of the county as given in the bullion tables.

At Sonora the quartz mines are mainly pocket mines in small, rich veins, the most noted of which is the O'Hara mine, which made a small yield in 1907, but since the close of the year is reported to have produced very largely and has attracted great attention. The ore is pounded up in hand mortars, there being no mill at the mine. On this property there is a shaft 600 feet deep. At Soulsbyville the Bagdad-Chase Mining Company has, since June, 1907, been producing bullion from the old Soulsby mine, which has been operated intermittently since 1860. There are 2 vertical shafts 800 feet deep and 1 incline shaft 800 feet deep. On the property is a 15-stamp mill, with plate amalgamation and concentrators, and also a slime plant. The Jumper Gold Syndicate of California (Limited), of Stent, has on its mine an incline shaft 1,400 feet deep and a winze 450 feet below that. There is an 80-stamp mill with plate amalgamation and concentrators on the property. At Tuttletown there are numerous small mines which made no considerable output in 1907.

Of the nonproducing quartz mines, of which there are many in the county, the Dreisam, at Carters, after being closed down for five years, has been unwatered, and good ore was reported to be found in 1908. The Goldwin Mining Company, of the same plece, has ceased operating and the mill has been removed from the ground. The United Mines Corporation, owning the Lady Washington, Grizzly, New Albany, Eureka, and Dead Horse, all former producers, did nothing in 1907, but the mill was started again in June, 1908. The Standard Gold Mining Company developed the Hardtack mine during 1907, but made no yield. The New Era, with its 10-stamp mill, was unproductive, but development work continued. The Gold Crater Mines Company, at Columbia, has erected a new mill, but there was no output for the year. The Mustang-Fair Oaks mine, at Confidence, with a 5-stamp mill, has been taken over by new parties, who are developing it.

At the Cosmopolite mine, Groveland, active milling operations commenced in February, 1908. The Clio, at Jacksonville, was under development during the year. Development was carried on at the Little Bonanza, the Sonora, and the Old Austrian and the Stonewall mines. The Black Oak mine, at Soulsbyville, has been unwatered and retimbered preparatory to extensive operations in 1908. The Floyd Mining Company, at Tuolumne, installed a mill in the fall of 1907, but it was only run a short time. The Rawhide mine made no production, but was started up again in 1908. Quite a number of idle mines, held by assessment work, have not been named in this brief review.

YUBA COUNTY.

Yuba County in 1907 produced 85,467.51 fine ounces of gold, valued at $1,766,770, and 9,374 ounces of silver, valued at $6,187, a total of $1,772,957. In gold production the county made by far the largest increase in the State, namely $494,952, and this is entirely due to the dredging operations near Marysville, where several large new machines were put in operation during the year. Of the counties showing an increase of gold yield, the aggregate value was $766,347, and to this increase Yuba contributed $494,952. The placers of the county yielded $1,746,972 in gold, and the deep mines yielded $19,798 from 4,607 tons of ore. The placers yielded silver valued at $6,107, and the deep mines only $80, out of the total value of silver yield of $6,187. There were 6 deep mines operated and 43 placers; of these latter, 2 were hydraulic, 13 were dredges, 1 was a drift mine, and 27 were surface or sulicing mines. By far the largest part of the output came from dredging operations.

It was only in 1904 that dredging operations were inaugurated on the Yuba River, near Marysville, in this county, when the gold yield for the year was $74,263, as compared with $1,688,032 in 1907. In 1904, however, there were 2 dredges operating only a part of the year, while in 1907 there were 12 machines at work in this field, most of them for the entire year. The Marysville dredging field is quite extensive and bids fair to outlast the other dredging fields of the State. The conditions are very favorable for dredging operations, the gravel being deep and carrying very even averages. Two companies are operating at present in this field, one with 2 dredges and the other with 10 dredges, and still other machines are to be built. At Wheatland, in the same county, another dredge operated in 1907 was productive. Among other operations near Marysville the Archimedes Gold Dredging Company worked its ground by sluicing for part of the year, and the Marysville Tunnel and Quartz Mining Company also worked Yuba River gravel by sluicing and rockering. The Sunset Placer was worked productively in the same manner, and there are numbers of Chinese working in the same locality as well as elsewhere in the county. Some small placers were worked at Brownsville, Browns Valley, Comptonville, Dobbins, and Pike. At Smartsville the small Chinese placer mines were active. The old Paddy Campbell mine at this place is being reopened by the Tarr Mining Company in 1908, and the long ditch is being cleaned out and repaired. At Strawberry Valley little mining is being done. The

Bear River Mining Company, a subsidiary of the Oroville Dredging (Limited), is working a dredge near Wheatland, and there are several placers near Woodleaf which are producing.

As to quartz mining, the Dannenbroge and Pennsylvania Company, at Browns Valley, has a 10-stamp mill, with plate amalgamation and concentrators. The mine is being prospected and is productive. At Dobbins the Eagle, Good Title, Red Cross, and Hillside mines yielded production. In 1908 considerable activity was begun in quartz mining in this county, brought about mainly by the discovery of very high grade ore in a new mine called the Solano Wonder, at Brownsville. The same conditions occur in the county northeast of Marysville, and the miners expect to strike veins which were the source of the gold at Smartsville and other formerly productive localities. Recent operations have thus brought Yuba County prominently to the front again as a gold-producing region, after many years of obscurity, the result of the closing down of the productive hydraulic mines. In this connection it may be noted that the Brandy City and Scales diggings are working in 1908 a large force of men, preparing for operations again. The mines have been closed down since hydraulic mining was stopped.

OTHER COUNTIES.

Alpine County.—In this county are the 16-stamp mill of the Alpine Mining Company and the 20-stamp mill of the Nevada-Hercules Mining Company, both near Loope, but no reports were received from any productive mines in 1907.

Colusa County.—From this county there was a small yield, valued at $742, from one property.

Del Norte County.—In this county 2 hydraulic and 4 surface placers were worked productively in 1907, and yielded $878 in gold and $3 in silver, a total of $881, which is $5,098 less than was produced in the county in 1906. The few mines are at Crescent City and Monumental.

Fresno County.—This county produced gold valued at $2,401 in 1907 and silver valued at $26, a total of $2,427. In 1906 this county produced $8,493 in gold, $83 in silver, and 440,000 pounds of copper worth $84,920, a total of $93,496. The falling off in value of yield for the county from 1906 was therefore $91,069. No returns were received from producing copper mines in Fresno in 1907. The few producing mines of 1907 were at Toll House, Auberry, and Pollasky.

Los Angeles, Orange, and Ventura counties.—These three counties in 1907 produced $11,214 in gold, $11,066 in silver, and 14,000 pounds of lead worth $742, a total value of $23,022. There was only 1 producer in Orange County and 1 in Ventura County. In Los Angeles there were 3 productive mines—at Acton, Shoemaker, and Cajon. All the producers in the three counties were lode mines. The Lowell and California Mining Company, at Acton, has a 10-stamp mill, and the Native Son, at Cajon, has a 3-stamp mill.

Madera County.—In Madera County 8 gold quartz mines, 1 copper mine, and 2 surface placer mines were productive in 1907. The total output was $13,303 in gold, $506 in silver, and 23,964 pounds of copper, valued at $4,793, a total value of $18,602. The total value of the product in 1906 was $22,898; hence the falling off in value of yield for 1907 was $4,296. The productive mines were at Daulton, Coarse Gold, and O'Neals. There were 1,790 tons of ore worked in the county in 1907. This was from the California and Nevada Company at Daulton; the Texas Flat and Consolidated Fair, at Coarse Gold; and the Misfortune, Eliza Jane, Hanover, and Mud Springs mines, at O'Neals.

Merced County.—In this county only 2 mines yielded production in 1907, and their combined output was $832. Late in 1908 a new dredger was started at work in the Merced River near Snelling, the first operation of the kind in that region.

Monterey County.—There were worked in this county 3 deep mines in 1907 and 1 placer, all at Jolon. The total output of these mines was valued at $1,085.

Riverside County.—The production of this county in 1907 was $3,836 in gold and $26 in silver, a total of $3,862, which was $811 less than 1906. There were 4 deep mines operated and 2 sluicing mines. The deep mines are at Indio, Paloverde, and Perris. There were only 178 tons of ore worked.

San Diego County.—This county produced $7,455 in gold and $35 in silver in 1907, a total of $7,490. There was 1 producing surface mine—a dry washer—and 6 quartz mines, the latter yielding 374 tons of ore during the year. These productive quartz mines were at Julian, and comprised the El Ranchito, Ready Relief, O. K., Evans, Eagle, and Gilson mines. There are many idle mines in the county. The Nobles Gold Mines, Limited, at Descanso, has a 5-stamp mill and a roller mill, but only assessment work was done during the year, though the mine is well developed. The old Stonewall mine at Cuyamaca, once a large producer, has been idle for three years. At Escondido the Cleveland-Pittsburg Mining Company has a small mill with concentrators, all new, and began active operations in July, 1908. The Encinitas Copper Mining Company, at Encinitas, did nothing during the year. The Julian and Banner district mines made only small outputs. A new district called Dulzura was discovered in 1907, but no yield has been made, as there are no mills. In that part of San Diego County which has lately been segregated as Imperial County the Paymaster Mining Company (Cargo Muchacho) was idle, as was the American Boy, at Ogilby. The Golden Cross mine, with its milling plant of 140 stamps and its extensive development, yielded nothing and has done nothing since the tailings were cyanided in 1905. The California King mine, owned by the Picacho Basin Mining Company, was under development only.

San Luis Obispo County.—The total output of this county was valued at $316, from a few placer mines at La Panza.

Stanislaus County.—In this county only 1 deep mine was operated productively in 1907, and 1 placer mine, with a yield of $3,364 in gold and $28 in silver, a total of $3,392.

Lassen and Modoc counties.—Neither of these counties made any yield in 1907, though Lassen did in 1906. Its single quartz mine, at Hayden Hill, was closed during 1907. A new mining company, with a 10-stamp mill, began operations in the county in 1908. In Modoc County the Hoag district mines, at Fort Bidwell, are being developed, and a custom mill has been erected, but there has as yet been no yield.

COLORADO.

By Chester Naramore.

PRODUCTION.

The total value of the gold, silver, copper, lead, and zinc production of the mines of Colorado for the calendar year 1907, as reported to the Geological Survey, amounted to $37,423,838, or approximately $6,315,000 less than 1906. There were decreased quantities of gold, silver, lead, and zinc mined in 1907, but an increased quantity of copper.

The gold output decreased from 1,122,814.18 fine ounces, valued at $23,210,629, in 1906, to 1,007,467.14 fine ounces, valued at $20,826,194, in 1907, a falling off in value of $2,384,435. The placer mines produced 4,877.65 fine ounces of gold, valued at $100,830, and 1,906 fine ounces of silver, valued at $1,258.

The silver product of Colorado amounted to 11,229,776 fine ounces, valued at $7,411,652, a decrease in quantity of nearly 1,000,000 fine ounces as compared with the output of 1906.

The combined value of the precious metals decreased $3,158,059 in 1907 and totaled $28,237,846. Production was reported from 29 counties and by 642 mines, of which 591 were deep mines and 51 were placers, as compared with reports from 664 mines in 1906, including 626 deep mines and 38 placers.

There were 2,383,128 short tons of ore mined in 1907, a decrease of 265,795 tons from the total for 1906.

The siliceous ores amounted to 1,691,646 short tons, or over seven-tenths of the total tonnage. Clear Creek, Ouray, Lake, Pitkin, and San Miguel counties made large increases of this class of ore in 1907, while large decreases were reported from Gilpin, Gunnison, Mineral, Summit, and Teller counties. The average recovered value per ton in gold and silver from siliceous ores dropped from $14.90 in 1906 to $14.49 in 1907.

There were 22,619 tons of copper ore mined in Colorado in 1907, about two-thirds as much as in 1906, and most of this tonnage was furnished by the mines of San Juan and Chaffee counties.

A slightly increased tonnage of lead ores was reported in 1907, but the average recovered value of precious metal values decreased from $8.75 per ton in 1906 to $7.72 per ton in 1907. Lead ores composed a little over 13 per cent of the total tonnage mined in the State.

Zinc ore dropped off in 1907 almost one-half, but the contained precious metal values increased from $1.60 per ton in 1906 to $2.63 in 1907. Summit County produced most of the pure zinc ores.

The copper-lead ores increased fourfold, but the value per ton in recovered gold and silver values dropped from $16.38 in 1906 to $11.72 in 1907. San Juan, Ouray, and Hinsdale counties furnished most of this class of ore. Less than seven-tenths as much lead-zinc ores were reported in 1907 as in 1906, and a decrease from $3.21 per ton in 1906 to $2.42 per ton in 1907 is noted in the average recovered value in precious metals. The mines of Lake and Pitkin counties produced almost all of the lead-zinc ores.

The quantity of copper reported by the mines increased 2,003,661 pounds over that of 1906, and amounted to 7,724,590 pounds. This gain was due to the high price of the metal during the first half of 1907. The large decreases in lead and zinc in 1907, as compared with the productions of 1906, are accounted for in the decreased tonnage of ore mined in the larger silver-lead-zinc camps because of the closing of some of the larger mines in each camp during the latter part of 1907, when the metal prices declined so rapidly.

Each succeeding year witnesses the mining of a lower grade of ore in Colorado, as is shown by the yearly average metallic value per ton of all ores mined, which was $15.67 in 1907, as compared with $16.47 in 1906, with $17.37 in 1905, and with $17.89 in 1904.

Production of gold, silver, and associated metals in Colorado in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	1,122,814.18	$23,210,629	1,007,467.14	$20,826,194	−115,347.04	−$2,384,435
Silver............do....	12,216,830	8,185,276	11,229,776	7,411,652	− 987,054	− 773,624
Copper ......pounds..	5,720,929	1,104,139	7,724,590	1,544,918	+ 2,003,661	+ 440,779
Lead ....do....	104,102,269	5,933,829	85,406,849	4,526,563	−18,695,420	− 1,407,266
Zinc ....do....	86,965,308	5,304,884	52,788,326	3,114,511	−34,176,982	− 2,190,373
Total............		43,738,757		37,423,838		− 6,314,919

Production of gold, silver, copper, lead, and zinc in 1907, in Colorado, by counties.

County.	Producing mines.	Tonnage of deep mines.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ounces.*		*Fine ounces.*	
Boulder	38	8,000	7,820.20	$161,658	23,480	$15,497
Chaffee	14	14,592	3,645.73	75,364	38,465	25,387
Clear Creek	88	79,548	25,295.09	522,896	518,364	342,120
Custer	8	1,601	331.13	6,845	25,995	17,157
Dolores	8	1,575	565.46	11,689	33,037	21,804
Douglas	1		2.37	49		
Eagle	15	4,191	2,594.88	53,641	70,586	46,587
Fremont	4	162	14.61	302	561	370
Gilpin	84	87,887	45,399.36	938,488	209,347	138,169
Grand	1		.87	18		
Gunnison	17	18,078	2,978.40	61,569	27,277	18,003
Hinsdale	9	10,740	363.78	7,520	50,109	33,072
Huerfano	1	3	3.29	68		
Jefferson	2	18			73	48
Lake	70	631,273	51,504.38	1,064,690	4,154,913	2,742,243
La Plata	7	7,789	19,954.64	412,499	217,432	143,505
Mesa	1		3.68	76	3	2
Mineral	10	104,977	5,705.64	117,946	870,456	574,501
Montezuma	3	23	25.88	535	147	97
Montrose	1		15.19	314	9	6
Ouray	25	96,662	116,828.00	2,415,049	352,519	232.663
Park	24	12,661	24,826.82	513,216	111,215	73,402
Pitkin	20	183,836	28.01	579	1,719,446	1,134,834
Routt	9	3	242.31	5,009	429	283
Saguache	4	170	31.40	649	6,194	4,088
San Juan	27	235,639	46,814.03	967,732	1,175,176	775,616
San Miguel	29	407,491	119,366.09	2,467,516	1,438,299	949,277
Summit	39	25,127	5,156.29	106,590	125,847	83,059
Teller	83	451,082	527,949.61	10,913,687	60,397	39,862
Total	642	2,383,128	1,007,467.14	20,826,194	11,229,776	7,411,652

Production of gold, silver, copper, lead, and zinc in 1907, etc.—Continued.

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Boulder	22,840	$4,568	16,491	$874	....	....	$182,597
Chaffee	799,505	159,901	630,623	33,423	2,091,489	$123,398	417,473
Clear Creek	171,340	34,268	2,804,172	148,621	1,406,187	82,965	1,130,870
Custer	8,420	1,684	103,585	5,490	....	....	31,176
Dolores	99,495	19,899	54,547	2,891	12,649	746	57,029
Douglas	....	....	....	....	....	....	49
Eagle	14,270	2,854	193,690	10,266	507,949	29,969	143,317
Fremont	30,330	6,066	....	....	....	....	6,738
Gilpin	874,060	174,812	611,060	32,386	....	....	1,283,855
Grand	....	....	....	....	....	....	18
Gunnison	13,690	2,738	120,226	6,372	68,644	4,050	92,732
Hinsdale	99,410	19,882	1,204,628	63,845	23,034	1,359	125,678
Huerfano	....	....	....	....	....	....	68
Jefferson	1,955	391	....	....	....	....	439
Lake	2,679,510	535,902	32,519,796	1,725,549	37,412,374	2,207,330	8,273,714
La Plata	....	....	340	18	....	....	556,022
Mesa	....	....	....	....	....	....	78
Mineral	....	....	10,656,962	564,819	1,838,136	108,450	1,365,716
Montezuma	....	....	....	....	....	....	632
Montrose	....	....	....	....	....	....	320
Ouray	410,720	82,144	3,496,958	185,339	30,407	1,794	2,916,989
Park	....	....	1,062,732	56,325	333,407	19,671	662,614
Pitkin	10,735	2,147	12,235,230	648,467	5,799,746	342,185	2,128,212
Routt	....	....	....	....	....	....	5,292
Saguache	1,260	252	22,528	1,194	....	....	6,183
Jan Juan	2,450,280	490,056	12,483,507	661,626	237,677	14,023	2,909,053
San Miguel	14,905	2,981	5,274,641	279,556	....	....	3,699,330
Summit	21,865	4,373	1,915,133	101,502	3,026,627	178,571	474,095
Teller	....	....	....	....	....	....	10,953,549
Total	7,724,590	1,544,918	85,406,849	4,526,563	52,788,326	3,114,511	37,423,838

The year 1907 opened with the mining industry in Colorado in a very flourishing condition and with every indication that a record mineral production would be made by the different districts. While the conditions were so favorable, with high metal prices and freedom from labor troubles, much development work was in progress and there was a shortage of experienced miners at some of the gold camps. But with the falling off in metal prices, which began in July, the production from the silver-lead-zinc mines not only decreased rapidly, but many producing mines temporarily ceased operations. The following money stringency closed many more small shippers and developing properties, so that toward the end of 1907 there was such a shortage of ore at the smelters that some of the plants found it necessary temporarily to blow out some of the furnaces and to lay off many men. These changed conditions caused many miners to turn their attention to gold mining, and many leases were taken up which would not have been acceptable in the earlier months of the year. Thus by the first of 1908 an increased tonnage of gold ores was being sent to the mills and smelters, so that 1908 promises to furnish an increased gold output, especially from the Cripple Creek district. The long-continued low metal prices during the first portion of 1908 have retarded the mining industry so that there will probably be a decreased output of all the metals, with the exception of gold.

Of considerable interest to the mining industry was the increased activity of power companies throughout the State in 1907. Four large companies were either operating or constructing power plants in the central and north central portions of the State. The Northern Colorado Power Company has a 12,000-horsepower steam plant near the coal fields at Lafayette. The Summit Power Company, near Breckenridge, depends upon the waters of the Snake River and Straight Creek for 2,500 horsepower. The Eastern Colorado Power Company conveys the waters of the Middle Boulder from Nederland almost to Boulder, where a 1,850-foot head is obtained for power purposes. The Central Colorado Power Company's plans include the developing of 80,000 horsepower from the Grand River near Glenwood Springs and 20,000 horsepower from Gore Canyon. In the San Juan hydro-electric power has been furnished the mines for some time by the plants in San Juan and San Miguel counties. The water from Clear Creek is used once just below Georgetown and again just below Idaho Springs, thus supplying the mines of this section with electric power.

Tonnage of ore sold or treated, number of mines producing, and average total value per ton of ore reported by deep mines in Colorado in 1906 and 1907, by counties.

County.	Total tons of ore sold or treated.		Number of mines producing (including placers).	
	1907.	Increase (+) or decrease (−).	1906.	1907.
	Short tons.	*Short tons.*		
Boulder	8,000	+ 2,472	44	38
Chaffee	14,592	+ 458	16	14
Clear Creek	79,548	+ 14,774	71	88
Conejos		− 85	1	
Costilla		− 28	2	
Custer	1,601	− 1,942	12	8
Delta			1	
Dolores	1,575	− 667	8	8
Douglas			1	1
Eagle	4,191	− 11,795	16	15
Fremont	162	− 848	3	4
Garfield			2	
Gilpin	87,887	− 26,775	90	84
Grand				1
Gunnison	18,078	− 13,025	20	17
Hinsdale	10,740	+ 3,654	16	9
Huerfano	3	+ 3		1
Jefferson	18	+ 13	1	2
Lake	631,273	− 40,782	61	70
La Plata	7,789	+ 32	8	7
Larimer		− 460	1	
Mesa			1	1
Mineral	104,977	− 21,187	13	10
Montezuma	23	+ 23	1	3
Montrose			1	1
Ouray	96,662	+ 48,194	23	25
Park	12,661	+ 2,589	16	24
Pitkin	183,836	− 19,564	27	20
Rio Grande		− 70	2	
Routt	3	+ 3	8	9
Saguache	170	− 829	7	4
San Juan	235,639	+ 39,201	26	27
San Miguel	407,491	+ 20,756	21	29
Summit	25,127	− 8,923	39	39
Teller	451,082	−250,987	105	83
Total	2,383,128	−265,795	664	642
Average value per ton			$16.47	$15.67

Number of mines in Colorado, classified by chief product, in 1907, by counties.

County.	Gold placer mines.			Deep mines.												Total mines producing.
	Hydraulic.	Surface.	Dredge.	Gold.	Silver.	Copper.	Lead.	Zinc.	Gold-silver.	Gold-silver-copper.	Gold-silver-lead.	Gold-copper.	Silver-lead.	Copper-lead.	Lead-zinc.	
Boulder				34	1				2			1				38
Chaffee	3			1	2	4	2	1		1						14
Clear Creek		3		26	17	1	4	2	19	[a]6	3	1	[b]4		2	88
Custer					3	2	1		1				1			8
Dolores					4	2			2							8
Douglas		1														1
Eagle		1		6	3	1		1	1		1		1			15
Fremont				1		3										4
Gilpin		6		58	2	5			6		3	[a]4				84
Grand		1														1
Gunnison				8	1		1			1	1		3		2	17
Hinsdale					2	1	3						2	1		9
Huerfano				1												1
Jefferson						2										2
Lake		6		4	21	2	13	2	8	1	1	1	6		2	70
La Plata				7												7
Mesa		1														1
Mineral					6		4									10
Montezuma				3												3
Montrose		1														1
Ouray				5	9	3			4				1	3		25
Park	2	6		5	8			2	1							24
Pitkin					14		1		1				[b]4			20
Routt	1	6	1						1							9
Saguache				1	1		2									4
San Juan				5	5	[c]3	4		2	[a]2	3		2	[d]1		27
San Miguel		2		11			1		3	1	6		2			29
Summit	3	6	1	5	[c]3		[f]5	[c]3	[e]4		2	1	5		1	39
Teller				83												83
Total	9	40	2	267	105	29	41	11	55	12	20	8	31	5	77	642

[a] One gold-silver-copper-lead mine.
[b] One silver-lead-zinc mine.
[c] One copper-lead-zinc mine.
[d] One silver-copper-lead mine.
[e] One gold-silver-zinc mine.
[f] One gold-lead mine.

GOLD.

The decrease of $2,384,435 in the total value of gold mined in Colorado in 1907, as compared with that of 1906, is almost a million dollars less than the decrease made in Teller County alone. Thus reviewed as a whole, the gold-mining industry in Colorado was in a flourishing condition in 1907, since there was really an increased production of $955,123 from the rest of the State, excluding the Cripple Creek district, where the falling off was largely due to the burning of the Golden Cycle mill at Colorado City.

Substantial gains were made in the gold totals of Chaffee, La Plata, Ouray, Park, San Juan, and San Miguel counties, while notable decreases were made in Boulder, Custer, Gilpin, Gunnison, Hinsdale, Lake, Mineral, Summit, and Teller counties. Gold was mined in 28 counties in 1907, or in 4 less than in 1906. The counties which produced more than $500,000 in gold include Teller, with $10,913,687; San Miguel, with $2,467,516; Ouray, with $2,415,049; Lake, with $1,064,690; San Juan, with $967,732; Gilpin, with $938,488; Clear Creek, with $522,896; and Park County, with $513,216.

The siliceous or dry ores constituted 71 per cent of the total tonnage mined, and furnished over 94 per cent of the total gold product of the State. Four per cent of the gold totals was derived from lead ores, and the remainder, or 2 per cent, was won from copper ores, zinc ores, copper-lead ores, zinc-lead ores, and from placer mines.

There were 8,827.39 fine ounces of gold mined in copper ores in Colorado during 1907, a decrease of 362.19 fine ounces from the output of 1906. Gilpin, Ouray, and Lake counties were the chief producers.

Lead ores furnished 40,725.26 fine ounces of gold, or more than twice as much as in 1906. Park, Mineral, Ouray, Lake, Chaffee, and San Juan counties were the principal sources of this gold.

Chaffee and Summit counties supplied a little gold from zinc ores, and Lake County furnished from lead-zinc ores most of its gold, which amounted to 1,695.59 fine ounces, a little over one-seventh of the output of 1906.

Gold production from copper-lead ores increased from 355.41 fine ounces in 1906 to 1,303.81 fine ounces in 1907.

In 1907 the placer gold product was valued at $100,830, or less than one-half of 1 per cent of the total output of Colorado. The largest producers were Summit and Chaffee counties. Chaffee, Clear Creek, Eagle, Gilpin, and Lake counties reported larger placer cleanups than in 1906, while reduced savings were made from the placer mines of Park, Routt, and San Miguel counties. As in 1906, dredge operations contributed to the placer product in Summit and Routt counties, and hydraulic mines were active in Chaffee, Park, Routt, and Summit counties. Some placer gold was also won in Douglas, Grand, Mesa, and Montrose counties during the year.

Source of gold product in Colorado in 1907, by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.						Total.
		Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.	Lead-zinc ores.	
Boulder	....	7,201.53	618.67	....	....	....	....	7,820.20
Chaffee	1,711.17	4.99	456.61	1,396.97	23.36	52.63	....	3,645.73
Clear Creek	556.84	23,653.89	67.92	868.99	....	16.69	130.76	25,295.09
Custer	....	330.69	.44	....	....	....	....	331.13
Dolores	....	433.20	.72	131.54	....	....	....	565.46
Douglas	2.37	....	....	....	....	....	....	2.37
Eagle	20.27	2,553.47	6.34	....	....	....	14.80	2,594.88
Fremont	....	2.03	12.58	....	....	....	....	14.61
Gilpin	83.21	41,531.57	3,616.67	167.91	....	....	....	45,399.36
Grand	.87	....	....	....	....	....	....	.87
Gunnison	....	2,944.93	10.25	23.22	....	....	....	2,978.40
Hinsdale	....	18.86	1.16	250.49	....	93.27	....	363.78
Huerfano	....	3.29	....	....	....	....	....	3.29
Jefferson	....	....	....	....	....	....	....	....
Lake	95.88	45,749.75	1,373.51	2,875.98	....	....	1,409.26	51,504.38
La Plata	....	19,954.64	....	....	....	....	....	19,954.64
Mesa	3.68	....	....	....	....	....	....	3.68
Mineral	....	87.46	....	5,618.18	....	....	....	5,705.64
Montezuma	....	25.88	....	....	....	....	....	25.88
Montrose	15.19	....	....	....	....	....	....	15.19
Ouray	....	111,198.06	2,079.65	3,303.33	....	223.21	23.75	116,828.00
Park	336.34	459.08	....	24,031.40	....	....	....	24,826.82
Pitkin	....	18.09	....	....	....	9.92	....	28.01
Routt	237.43	4.88	....	....	....	....	....	242.31
Saguache	....	31.06	....	....	....	.34	....	31.40
San Juan	....	44,437.74	582.87	1,057.69	....	735.73	....	46,814.03
San Miguel	14.17	119,093.89	....	210.33	....	47.70	....	119,366.09
Summit	1,800.23	1,759.50	....	789.23	565.99	124.32	117.02	5,156.29
Teller	....	527,949.61	....	....	....	....	....	527,949.61
Total	4,877.65	949,448.09	8,827.39	40,725.26	589.35	1,303.81	1,695.59	1,007,467.14

SILVER.

During 1907 the mines of Colorado produced 11,229,776 fine ounces of silver, valued at $7,411,652. This is a decrease in quantity of 987,054 fine ounces and in value of $773,624 from the output in 1906, and is about equivalent to the quantity of silver mined in 1905.

Of the 26 counties reporting a silver production in 1907, 14 made smaller outputs than in 1906, but the falling off in the state total was largely due to the decreases in Clear Creek, Custer, Mineral, Ouray, Pitkin, and San Miguel countries. The largest increases in the silver output were made by San Juan, Lake, and La Plata counties. Eighty-eight per cent of the total silver production of the State in 1907 was mined in 6 counties, which rank according to output as follows: Lake, Pitkin, San Miguel, San Juan, Mineral, and Clear Creek.

Siliceous ores furnished 7,409,999 fine ounces, or nearly 66 per cent of the silver output of the State for 1907, as compared with 52 per cent in 1906. Silver from lead ores decreased 1,078,223 fine ounces and amounted to 2,357,981 fine ounces, or a little over one-fifth of the total silver output; and the silver content of the lead-zinc ores decreased 849,579 fine ounces, and amounted to 1,166,232 ounces, or slightly more than one-tenth of the entire production. The combined recovery from copper ores, zinc ores, copper-lead ores, and from placers furnished the remaining 3 per cent. The large decreases in silver from lead ores and from lead-zinc ores were due largely to reduced productions of this class of ore from Lake and Pitkin counties.

Source of silver product in Colorado in 1907, by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.						Total.
		Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.	Lead-zinc ores.	
Boulder		21,648	1,832					23,480
Chaffee	238	2,786	7,467	16,777	2,106	9,091		38,465
Clear Creek	170	413,755	2,765	62,304		1,573	37,797	518,364
Custer		22,077	15	3,903				25,995
Dolores		12,720	4,946	15,371				33,037
Douglas								
Eagle	6	29,578	2,191	10,879			27,932	70,586
Fremont			561					561
Gilpin	621	195,277	10,188	3,261				209,347
Grand								
Gunnison		18,210	3,879	450			4,738	27,277
Hinsdale		3,333	556	37,417		8,803		50,109
Huerfano								
Jefferson			73					73
Lake	88	2,519,596	22,097	1,089,153	576		523,403	4,154,913
La Plata		217,432						217,432
Mesa	3							3
Mineral		634,374		236,082				870,456
Montezuma		147						147
Montrose	9							9
Ouray		181,765	17,365	133,732		13,957	5,700	352,519
Park	68	7,985		103,162				111,215
Pitkin		988,241		176,740		11,203	543,262	1,719,446
Routt	38	391						429
Saguache		6,112				82		6,194
San Juan		646,612	69,168	407,567		51,829		1,175,176
San Miguel	3	1,412,551		24,463		1,282		1,438,299
Summit	662	15,012		36,720	49,491	562	23,400	125,847
Teller		60,397						60,397
Total	1,906	7,409,999	143,103	2,357,981	52,173	98,382	1,166,232	11,229,776

COPPER.

The mines of Colorado reported 7,724,590 pounds of copper, which, figured at 20 cents per pound (the average market price for 1907), was worth $1,544,918. This is a gain in quantity of 2,003,661 pounds, and in value of $440,779, over the mines report of 1906. These figures are much smaller than the actual quantity of copper produced from the ores mined in the State during 1907, but represent the quantity of copper for which the miners were paid. Many of the complex ores of Colorado contain a small percentage of copper that is not paid for by the ore buyers.

Eighteen counties reported a mine production of copper during 1907. Ranked according to output, the principal copper producing counties were Lake, San Juan, Gilpin, Chaffee, Ouray, and Clear Creek. Approximately two-thirds of the total copper output was mined in Lake and San Juan counties. There were 29 mines in which copper was the chief product; also 12 mines with gold, silver, and copper; 8 with gold and copper; and 5 with copper and lead as chief products, or 54 mines in which copper was one of the chief values. This metal constitutes a minor value in the ores of many other mines, and, in addition, occurs in less than pay quantities in a still larger number of mines in Colorado.

LEAD.

The quantity of lead mined in Colorado in 1907 was less by 18,695,420 pounds than in 1906, and amounted to 85,406,849 pounds, valued at $4,526,563. Gilpin, Hinsdale, Park, San Juan, and Summit counties made increased shipments of lead; but all of the other counties made smaller outputs for 1907 than in 1906. Especially was this so in Lake, Pitkin, Mineral, Ouray, and San Miguel counties, where the decreases exceeded a million and one-half pounds. The principal lead-producing counties, ranked according to output, were Lake, San Juan, Pitkin, Mineral, San Miguel, Ouray, and Clear Creek.

It will be noticed that the lead output from limestone replacement ores of Aspen and Leadville constitutes but 52 per cent of the total lead production of the State in 1907, as compared with 63 per cent in 1906. The decrease in quantity of lead mined in this class of ores amounted to 20,653,612 pounds, leaving a gain of 1,958,192 pounds of lead from ores mined in the other 17 lead-producing counties, chiefly from fissure veins.

ZINC.

The new zinc industry of Colorado received a temporary setback in 1907 when the metal prices declined, and the output amounted to only 52,788,326 pounds, valued at $3,114,511, a little more than three-fifths of the total for 1906.

The decrease in zinc production in Lake County amounted to 34,290,347 pounds, or 113,365 pounds more than the total decrease for the entire State. In 1906 Lake County furnished 82 per cent of the zinc output of the State, as compared with 71 per cent in 1907. Larger productions were reported from Chaffee, Ouray, Park, Pitkin, and Summit counties, while Clear Creek, Dolores, Eagle, Fremont, Gunnison, Hinsdale, Lake, Mineral, and San Juan counties made smaller zinc shipments than in 1906.

The zinc production in Colorado is almost wholly secondary to the production of silver and lead, and is largely obtained by separating the silver-lead values from the zinc, in order to make two marketable products from ore otherwise unsalable. Thus when the price of any one of the three metals is low the zinc output is apt to be curtailed, as the extra cost of concentrating and separating reduces the margin of profit on the zinc-bearing ores.

As explained in previous reports, to obtain absolutely accurate figures to represent the zinc product of the mines of Colorado is very difficult, and would involve an unwarrantable expenditure of time and money. The printed figures represent the mine estimate of the survey after reviewing the returns in detail and with much care. No hard and fast rule is applicable in estimating the probable zinc recovery from the complex zinc-bearing ores and concentrates of Colorado, as the shipments are often reconcentrated, with an additional loss, before retorting or are mixed with higher-grade ores from other localities in preparing the retort charge, so that the miner or producer has little if any idea as to the actual metal recovery, and the smelting companies can only furnish an estimate as to the probable recoveries of ore from each of the different localities involved.

In estimating the zinc figures for 1907 each individual shipment was considered and losses ranging from 20 to 40 per cent were allowed in accordance with the percentage of the zinc in the ore or concentrate and with the reconcentration or lack of reconcentration of the ore.

MINES REPORT AS COMPARED WITH SMELTER RETURNS.

The figures of production of Colorado in 1907 for lead, copper, and to a smaller extent for silver, as compiled from smelter returns, are considerably larger than those given here in the mines report. This difference is due to the fact that the mine production dropped off so rapidly during the last months of 1907 that the smelters were able to use up their entire stock of ore on hand before the end of the year, instead of carrying the usual reserve supply over to 1908. Therefore, a portion of the lead, copper, and silver marketed by the reduction companies in 1907 was provided for in the mine production for 1906.

In years when mine operations and smelter operations are normal the stock of ore carried over from any one year to another is almost a constant quantity, but since the reduction works were run at full capacity for a longer period during 1907 than some of the mines the ore reserves were depleted.

List of active Colorado smelting plants in 1907.

City.	Plant.	Owner.
Denver	Globe	American Smelting and Refining Co.
Pueblo	Pueblo	Do.
Do	Eilers	Do.
Do.[a]	United States Zinc Co.	Do.
Leadville	Arkansas Valley	Do.
Durango	Durango	Do.
Denver	Argo	Boston and Colorado Smelting and Refining Co.
Canyon City[a]		United States Smelting Co.
Salida		Ohio and Colorado Smelting and Refining Co.
Silverton[b]	Kendrick & Gelder	Ross Mining and Milling Co.

[a] Zinc-copper ores.

[b] Pyritic smelting.

Subdivision of crude ore sold or treated in Colorado in 1907, by counties, in short tons.

County.	Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.	Lead-zinc ores.	Total.
Boulder	7,684	316	....	....	....	....	8,000
Chaffee	66	6,537	2,712	4,842	435	....	14,592
Clear Creek	73,017	132	3,573	50	79	2,697	79,548
Custer	1,352	16	233	....	....	....	1,601
Dolores	117	1,181	277	....	....	....	1,575
Douglas	....	....	....	....	....	....	....
Eagle	2,723	49	58	....	....	1,361	4,191
Fremont	2	160	....	....	....	....	162
Gilpin	85,698	1,880	309	....	....	....	87,887
Grand	....	....	....	....	....	....	....
Gunnison	17,765	125	33	....	....	155	18,078
Hinsdale	60	15	9,362	....	1,303	....	10,740
Huerfano	3	....	....	....	....	....	3
Jefferson	....	18	....	....	....	....	18
Lake	272,728	1,549	156,799	624	....	199,573	631,273
La Plata	7,789	....	....	....	....	....	7,789
Mesa	....	....	....	....	....	....	....
Mineral	29,991	....	74,986	....	....	....	104,977
Montezuma	23	....	....	....	....	....	23
Montrose	....	....	....	....	....	....	....
Ouray	91,763	578	1,677	....	2,549	95	96,662
Park	1,041	....	11,200	420	....	....	12,661
Pitkin	50,008	....	10,136	....	99	123,593	183,836
Routt	3	....	....	....	....	....	3
Saguache	149	....	....	....	21	....	170
San Juan	187,242	10,063	35,201	....	3,133	....	235,639
San Miguel	406,650	....	822	....	19	....	407,491
Summit	4,690	....	3,222	11,812	203	5,200	25,127
Teller	451,082	....	....	....	....	....	451,082
Total	1,691,646	22,619	310,600	17,748	7,841	332,674	2,383,128
Average recovered value in gold and silver per ton	$14.49	$12.24	$7.72	$2.63	$11.72	$2.42	$11.81

REVIEW BY INDIVIDUAL COUNTIES.

BOULDER COUNTY.

The total value of the production of gold, silver, copper, and lead from the mines of Boulder County in 1907 was $24,250 less than in 1906. The gold output fell off $27,111, and amounted to 7,820.20 fine ounces, valued at $161,658. The lead output decreased in quantity 31,000 pounds and in value $1,833, and amounted to slightly more than one-third of the total for 1906. The silver production increased from 21,923 fine ounces, valued at $14,688, in 1906, to 23,480 ounces, valued at $15,497, in 1907, a gain of 1,557 fine ounces. Over six times as much copper was reported in 1907 as in 1906.

There was an increase in tonnage of 2,472 short tons, but the number of producing mines decreased from 44 in 1906 to 38 in 1907, and the average total value recovered per ton of ore from $37.42 to $22.82. This large decrease in average value per ton was due to the handling of a much greater tonnage of low-grade ore in a cyanide plant in the Central district.

The value of the tungsten mined during 1907 exceeded the combined values of the other 4 metals in Boulder County. The early completion of the power lines of the Northern Colorado Power Company into the mining districts of the county promises much for the mining industry, and the Eastern Colorado Power Company also plans to supply power from a hydro-electric plant on the Middle Boulder.

Central district.—There was more than twice as much gold produced as in 1906, but a smaller quantity of silver was won from this district during 1907. The Monarch Consolidated Company reduced the ore from the Wano group in its new 100-ton cyanide mill at Jamestown. The roaster was of a capacity of 35 tons in 1907, but the company planned to install another furnace during 1908. Shipments during 1907 from the Invincible mine were limited to fluorspar.

Gold Hill district.—This district continues to be the most important gold-producing section of the county, but 14 mines producing in 1907, as compared with 15 in 1906, reported a greatly reduced tonnage and production of gold, silver, and lead. The total value decreased from $77,617 in 1906 to $51,250 in 1907. The principal producing mines include the Cash Birkin, Golden Eagle, Slide, Ingram, Richmond and Marquette group, and the Black Cloud. The year 1907 was spent in development work and in erecting a 50-ton cyanide mill at the Inter-Ocean mine at Sunshine. The production of the Slide mine was hindered by the destruction of the hoisting plant by fire. Development work was reported by the Burlington-Boulder Mining and Milling Company, the New York-Union Gold Mining Company, and the St. Joe Mining Company. The Five Points Gold Mining Company began shipping in 1908 from the Atlantic mine, which is opened by a 567-foot crosscut tunnel.

Grand Island district.—The production from the Grand Island district shows a decreased tonnage in 1907 as compared with that of 1906, but a greater gold and silver output, the total value increasing from $4,114 in 1906 to $5,776 in 1907. The Lagonda Mining and Milling Company made some shipments of high-grade gold ore extracted in doing development work on the 400-foot and 500-foot levels of the Revenge mine above Eldora. Small shipments were also reported from the Pine Grove Mining and Milling Company.

Tunnel development was reported by the following companies about Eldora: The Denver Transportation and Drainage Tunnel and Mining and Reduction Company; the Swarthmore Consolidated Mining Company; the Consolidated Copper Mining, Milling, and Smelting Company; and the Highland Mary Mining, Milling, and Power Company. The Larimore Gold Mining and Milling Company made a sample shipment of high-grade gold ore from the Bonanza mine. The Cashier Mining and Milling Company erected a 50-ton dry concentrating plant in 1907 to handle low-grade silver-lead ores from the Albion mine in the Snowy Range section.

Magnolia district.—An increased tonnage of lower-grade ore than was mined in 1906 was handled in the Magnolia district in 1907, resulting in a decreased gold output. The Cash mine was the chief producer of this section, and the ore was treated in a 10-ton cyanide plant. A small production of high-grade gold ore was made by lessees at the Mountain Lion mine. The India Gold Mining Company reported development work.

Sugar Loaf district.—There was a large falling off in tonnage, in quantity of gold, and in total value of output from the Sugar Loaf district in 1907 as compared with 1906, but the quantity of silver almost doubled the output of 1906. The Clinton Mining and Milling Company extracted some high-grade siliceous ore from the Logan group at Crisman, and the Gold Lode Mining Company made shipments from the Gold Lode mine at Wallstreet and from the Victoria mine at Salina. The Good Luck Mining and Milling Company started a 15-ton cyanide plant. Only small shipments were made by the U. S. Gold Corporation, as this company is erecting a 200-ton cyanide plant to treat the ore from the Livingston mine.

Ward district.—The Ward district ranked second only to the Gold Hill district in the total value of metallic output, and furnished most of the small copper and lead production of the county in 1907. Copper ore carrying precious metal values was shipped from the Dew Drop-Ni Wot mines and from the Moonlight mine, and high-grade siliceous gold ore was taken from the Poorman-Relief mine. The Utica Hill Gold Mining Company operated only 3 months in 1907, and the mill ore was stacked on the dump. The Struggler group is equipped with a mill containing 10 stamps, a 5-foot Huntington mill, and copper plates followed by concentrating devices.

CHAFFEE COUNTY.

Production of gold, silver, and associated metals in Chaffee County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold................fine ounces..	2,804.05	$57,965	3,645.73	$75,364	+ 841.68	+$17,399
Silver......................do....	54,609	36,588	38,465	25,387	− 16,144	− 11,201
Copper..................pounds..	349,466	67,447	799,505	159,901	+ 450,039	+ 92,454
Lead........................do....	1,227,019	69,940	630,623	33,423	− 596,396	− 36,517
Zinc.........................do....	717,703	43,780	2,091,489	123,398	+1,373,786	+ 79,618
Total......................	....	275,720	....	417,473	....	+141,753

The total value of the metals produced in Chaffee County in 1907 was more than half as large again as in 1906, because of increased quantity of gold, copper, and zinc. The total quantity of gold was greater by 30 per cent and was derived from larger placer cleanups in the Granite district, and from increased gold savings from copper ores from the Turret district, and from lead ores in the Chalk Creek district.

The large decreases in the totals of silver and lead were caused by the mining of less silver-bearing lead and lead-zinc ores in the Monarch district in 1907.

There were two and three-tenths times as much copper mined in Chaffee County in 1907 as in 1906, mainly because of increased shipments from the Turret district, and likewise the quantity of zinc mined in the county was nearly three times as large because of the increased production from the Monarch district. In 1907, 11 deep mines furnished 14,592 short tons of ore as compared with a production of 14,134 short tons from 14 deep mines in 1906. The siliceous or dry ores decreased from 301 tons to 66 tons. The copper ores increased from 6,249 tons to 6,537 tons, and the lead, zinc, and lead-zinc ores increased from 7,019 tons in 1906 to 7,554 tons in 1907, but the copper-lead ores decreased from 565 tons to 435 tons.

The hydraulic mines at Granite made a fair increase over the output of 1906.

Chalk Creek district.—Large increases were made in 1907 in the tonnage and total value and in the quantities of gold, silver, copper, and lead produced in the Chalk Creek district, but the zinc output decreased more than one-fourth of the output of 1906. Mill building and increased tunnel work characterized the mining activity in this district. The J. A. J. Milling Company, operating the old Mary Murphy mine, furnished the bulk of the production from this district and reduced most of its ores in the Pawnee mill. The mill is equipped with 20 stamps, plates, and Wilfley tables. A small saving of bullion is made on the plates, and the shipments include lead concentrates carrying gold, silver, and small copper values, and zinc concentrates. A small quantity of lead ore bearing precious metals was shipped crude to the smelters. A 1,700-foot adit cuts the Mary Murphy vein at a depth of 1,165 feet, and the company is driving a 4,000-foot tunnel to intersect the vein 2,200 feet below the surface.

The values in the Flora Belle Mining Company's shipments were chiefly in silver. This company is also driving a crosscut tunnel to develop the mine which is now opened by a 100-foot inclined shaft and 200 feet of drifts. The Mary Murphy Reduction Company was erecting a 200-ton concentrating plant at St. Elmo. The Comstock crosscut tunnel was advanced 1,000 feet toward cutting the Comstock vein.

La Plata district.—Only small shipments of silver ore carrying low-grade gold values were made from this district in 1907.

Monarch district.—Four mines in 1907, as compared with six shippers in 1906, mined reduced tonnage containing much smaller quantities of gold, silver, copper, and lead than in 1906, but the zinc content was over three and one-half times as great as in 1906, and this caused the total value to increase. The zinc values constituted nearly two-thirds of the total value of the district in 1907.

The Madonna mine, at Monarch, operated by the Colorado Mines Exploration Company, and the Taylor Mountain Mining Company's Lilly group, at Garfield, were the principal producers in this section. Copper ores carrying silver, gold, and some lead values were shipped crude to the smelters from the Lilly mine, which is opened by a 2,250-foot adit and 4,500 feet of other development work. Lead ores bearing precious metals were shipped from the Hawkeye-Fairview properties, owned by the Vega Consolidated Mining Company, and from the Wilson group. Some development work was done by each of the following companies, principally by means of tunnels: The Garfield Mining, Milling and Smelting Company, the Hercules Mining Company, the Little Giant Mining and Investment Company, and at the Shamrock mine.

Riverside district.—The Harvard tunnel continues to be the most active property in the Riverside district. Slightly increased shipments of copper-lead ores bearing gold and silver were made in addition to considerable development work that was done during 1907.

Turret district (including Sedalia).—The mines of this district made substantial gains in the output of gold, silver, and copper, but the zinc production fell off. Both the quantity of copper and the total value of the metal output of the district were nearly three times as large in 1907 as in 1906. This district furnished over six-sevenths of the total copper output of the county in 1907.

Shipments of copper ore and concentrates carrying low precious metal values were made from the Sedalia copper mine by the Shawmut Consolidated Copper Company until late in July, 1907, when the 40-ton concentrating mill was closed. Development work was continued in the mine until late in December. Both sulphide and carbonate ores are found in the upper workings, and as quoted from Cross by Lindgren in Bulletin No. 340, the ore deposit is "a thick bed of actinolite schist, richly impregnated with copper minerals."[a] From near Turret productions were made by the Copper King mine and the Independence mine, while at the Gold Bug and Copperopolis mines the time was spent in development work. In the recent bulletin above referred to, W. Lindgren gives a brief review of the geology and ore deposits of this district.

CLEAR CREEK COUNTY.

Production of gold, silver, and associated metals in Clear Creek County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Decrease.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold....................fine ounces..	25,626.80	$529,753	25,295.09	$522,896	331.71	$6,857
Silver...........................do....	652,796	437,373	518,364	342,120	134,432	95,253
Copper ....pounds..	235,375	45,427	171,340	34,268	64,035	11,159
Lead ....do....	3,307,001	188,499	2,804,172	148,621	502,829	39,878
Zinc..............................do....	1,755,805	107,104	1,406,187	82,965	349,618	24,139
Total...........................	....	1,308,156	....	1,130,870	....	177,286

The production from the mines of Clear Creek County in 1907 showed a falling off in quantity and value for all 5 metals, as compared with 1906. Eighty-five deep mines produced 79,548 short tons of ore in 1907, as against 64,774 short tons from 67 deep mines in 1906. Although the tonnage increased, there was a large decrease in the average value per ton—from $20.14 in 1906 to $14.07 in 1907.

The tonnage of siliceous ore increased from 46,734 short tons in 1906 to 73,017 tons in 1907, but the other classes of ore fell off as follows: Lead ores from 11,483 tons to 3,573 tons, lead-zinc ores from 5,802 tons to 2,697 tons, copper ores from 455 to 132 tons, and copper-lead ores from 300 to 79 tons.

The gold decrease was slight, amounting to only $6,857. More gold was recovered from placer mines and from siliceous ores than in 1906, but less gold was mined in all other classes of ore.

The silver output from the county dropped from 652,796 fine ounces, valued at $437,373, in 1906, to 518,364 ounces, valued at $342,120, in 1907, a decrease in quantity of 134,432 fine ounces, or 20 per cent. There was much less silver recovered from all classes of ore in 1907, except from the copper-lead ores, which supplied more silver than in 1906. Less than three-fourths as much copper was reported in 1907, but this metal forms a small part of the total returns to the miners of Clear Creek County. The quantity of lead mined decreased over 500,000 pounds in 1907, and the zinc production was 349,618 pounds less than in 1906.

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[a] Bull. U. S. Geol. Survey No. 340, pt. 1, 1908, p. 163.

The large increase in the number of producing mines in 1907 as compared with 1906 represented small shipments from gold properties reopened by lessees during the latter portion of 1907, when work became slack at the lead-zinc camps and many miners were without employment.

Over five times as much gold was won from placer operations along Clear Creek during 1907 as in 1906, largely by small operators.

Argentine district.—With the same number of shipping mines and a slightly increased tonnage, the total value of the metal production from the Argentine district in 1907 fell off to a little more than half the values for 1906. The value of the gold decreased from $51,116 in 1906 to $15,403 in 1907, and the lead and zinc totals were each a trifle less than three-fifths of those of 1906. About the same quantities of silver and of copper were reported for both years. The value of silver produced in 1907 was $31,846 and of copper $2,159.

The Waldorf Mining and Milling Company continued to be the principal shipper of this section. Developments, including drifts at their 3 tunnels (the Argentine, the Tobin, and the Stevens), aggregate about 8 miles of workings. The Manhattan-Union Mining Company shipped zinc and lead concentrates carrying precious metal values from the Owsley mine, which is developed by a 270-foot shaft and 2,500 feet of drifts. The Santiago Consolidated Mining, Milling and Tunnel Company concentrated its ores in the company's 40-ton mill at Georgetown, and shipped concentrates carrying gold, silver, copper, and some lead to the smelters. The East Argentine Mining Company sent a portion of the ore from the Sidney tunnel to the smelter, crude, and the remainder to concentrating mills. The Josephine mine produced some lead ore. The St. Paul and the Robert E. Lee groups were being developed by means of tunnels during 1907.

Griffith district.—Eighteen mines shipped 20,046 short tons of ore from Griffith district during 1907, as compared with 13 mines and 18,231 tons in 1906. Greater quantities of gold, lead, and copper and smaller quantities of silver and zinc were reported in 1907, while the total value increased from $254,874 to $300,434. This district furnished 5 per cent of the gold, 29 per cent of the silver, nearly 70 per cent of the lead, and over 85 per cent of the zinc produced in the county during 1907, but during the last half of the year the low metal prices caused a number of operators in this section temporarily to suspend operations.

The Capital Mining and Tunnel Company probably attracted more attention than any other mining enterprise in the county in 1907. By January, 1908, the property was opened by a 3,000-foot tunnel and 400 feet of drifts on the vein, and development work has progressed steadily since. The values are principally in gold and silver. The company erected a mill in which the ore is handled by crushers, rolls, two 6-foot Chilean mills, amalgamating plates, 12 card tables, and 2 slime tables; the slime overflow goes to canvas tables.

The Mendota-Frostburg produced more values than any other mine of the district and furnished much of the lead and zinc output of that section. The mine is opened by a 2,000-foot tunnel and is equipped with a 40-ton jig concentrator.

The Democrat Mountain Mining, Milling and Transportation Company handled considerable ore from the Beecher-Boston mines in a 50-ton jig concentrator, making a heavy lead concentrate carrying small gold and silver values and a zinc product which was not marketed.

Reduced quantities of silver-lead ores were mined by the Aliunde Consolidated Mining Company, and the output of the Dives-Pelican also dropped off during 1907. Considerable shipments of gold-bearing lead ore were made from the Bellevue-Hudson and the Bellevue-Rochester mines. A smaller production was reported from the Terrible mine by the Whiting Mining and Milling Company, but the Two American Sisters mine made a larger output than in 1906.

Idaho district.—In this district are listed the mines about Idaho Springs, including Banner, Coral, Lower Fall River, Payne's Bar, Spanish Bar, and Virginia subdistricts.

Ten more mines reported a production from this territory in 1907 than in 1906, and the total tonnage increased 7,717 short tons, but smaller quantities of gold, silver, copper, and lead were mined, and the total value decreased from $463,217 in 1906 to $397,271 in 1907, of which $264,880 represents gold values and $105,529 represents silver. The small zinc output was much larger than in 1906, but this metal is a very minor factor in the production of the mines of the gold belt. Over four-fifths of the gold output and nearly three-fourths of the total value of the mineral production of the district were mined from the Consolidated Gem mines, the Little Mattie group, and the Shafter mine.

A greater tonnage was extracted from the Gem mines, including the Freighter's Friend mine, than in 1906, but it was of lower grade than in 1906. This mine is worked through the Newhouse tunnel. The Little Mattie mine, on Chicago Creek, made a slightly increased output during 1907. The Shafter mine developments include a 900-foot inclined shaft and a 4,370-foot crosscut tunnel. The ore is treated in the Hudson Reduction Company's 20-stamp plate-amalgamating and concentrating mill at Idaho Springs.

The Producer Mining Company made a greatly increased output in 1907 from the Silver Age and Franklin mines. Silver values predominated with smaller quantities of gold, lead, and copper. Less ore was extracted in 1907 than in 1906 from the Edgar mine by the Big Five Tunnel, Ore Reduction, and Transportation Company. The Stanley Mines Company has about 6 miles of underground workings and a 20-ton mill containing crushers, rolls, jigs, stamps, plates, and tables. The Almaden Mines Company made some shipments from its Fall River mine toward the end of 1907. Most of the shipments from the other mines of the district were small, and were to a limited extent incidental to development work. In addition to the producing mines, several properties report extensive development work for 1907, mostly by means of tunnels.

Jackson district.—In this district a large increase in the gold output was more than offset by decreased quantities of silver and lead mined in 1907, resulting in a small falling off in total values.

The American Gold Standard Mining Company made reduced shipments from its Black Eagle mine, the principal producer of the district. The Quito mine resumed shipments during 1907, and 3 other mines made small productions.

Montana district.—The Jo Reynolds mine continues to be the main source of ore for this district, but small productions were also reported from 3 other mines, inluding the Earl Kent, which operated for one month during 1907.

Trail district.—Trail district produced less than one-third of the values in 1907 that it did in 1906. Production was reported from the Champion mine, the Brighton mine, and the Old Stag mine. Some ore was extracted during development work at the Teller mine and at the Humboldt mine. Lessees made a considerable output at the Lamartine mine, which is opened by a 4,400-foot tunnel connecting with a 1,000-foot shaft.

Upper Union.—The mineral production from Upper Union, or Empire, district in 1907 was double the output of 1906. An increased tonnage was mined at the Specie Payment mine, which has about 2 miles of workings on the vein. The shaft is 600 feet deep and the tunnel is approximately 2,500 feet long. The Empire Tunnel also made a much larger production, principally in gold, and 4 other mines made shipments during the year from this section. A small quantity of good grade gold ore was shipped from the Yankee district, about Alice, during 1907.

CONEJOS AND COSTILLA COUNTIES.

No production was reported from either of these counties, but the Asiatic Tunnel Mining and Milling Company, operating in the Decatur district, Conejos County, reported the driving of 1,300 feet of a crosscut tunnel, which will be 3,000 feet long when it intersects the veins. The Pass-Me-By Tunnel Mining and Milling Company, in the same district, reports a 3,725-foot tunnel which cuts the veins at a depth of about 1,800 feet.

From the Grey Back district, about Russell, in Costilla County, the Mountain View Mining and Milling Company reported development work. The property is equipped with a 10-stamp plate-amalgamating mill, with concentrating tables.

CUSTER COUNTY.

The mineral output from Custer County in 1907 was less than one-half as large as in 1906. The total value amounted to $31,176, a decrease of $45,530. Eight mines shipped only 1,601 short tons, as compared with 3,543 tons from 12 mines in 1906. The gold product decreased in value from $16,318 in 1906 to $6,845 in 1907, and the quantity of silver dropped from 79,480 fine ounces to 25,995 fine ounces. The copper output increased from 2,725 pounds to 8,420 pounds, but there were only 103,585 pounds of lead shipped, as against 115,960 pounds in 1906.

Both the Bassick and the Bismuth mines (the two largest producers of the county), reduced their output during 1907. The Bassick furnished much of the gold, and the Bismuth mine a large percentage of the silver. Some silver-lead ore was taken from the old Bull Domingo mine during the year. Small productions were also made from the Democrat Mountain tunnel, the Horn Silver mine, the Humboldt mine, and the King of the Carbonates mine. In addition, the Rio Alto Copper Company made some test shipments of copper ore from the Hillside district. The Marion Mines and Mills Company was erecting a 100-ton concentrating mill to handle the ores from the Marion mine at Fairview. The ore is reported to carry zinc, gold, silver, and copper.

DOLORES COUNTY.

The total number of tons of ore mined in Dolores County in 1907 and the total values of the contained mineral products were a little more than seven-tenths as large as in 1906. A fair increase was made in the gold output and the silver decreased slightly, but much smaller quantities of base metals were shipped. The gold amounted to $11,689, a gain of $2,291 over 1906, and the silver totaled 33,037 fine ounces, a decrease of 1,253 fine ounces. The copper decreased from 199,379 pounds to 99,495 pounds; the lead from 118,229 pounds to 54,547 pounds; and the zinc dropped from 22,506 pounds to 12,649 pounds. The total value amounted to $57,029, or was $21,935 less than in 1906.

Lone Cone district.—The mines of this section were idle in 1906, but work was resumed in 1907. This district furnished over four-fifths of the gold and half of the silver of the county in 1907.

The principal producer of the district was the Emma mine, from which was shipped some high-grade gold and silver ore. Lessees mined some lead-silver ore, carrying small values in gold and copper, from the Swansea-Newman mine at Dunton. One shipment of fair grade gold and silver ore was shipped by the Milwaukee Gold Mining Company, which is developing its mine by means of tunnels.

Pioneer or Rico district.—The operations of 1907 about Rico resulted in a greatly reduced output of all metals. The United Rico Mines Company and Mr. Louis Haberman were the chief operators in this district. The United Rico Company was developing greater ore reserves and experimenting with the mill during the year. The ore is a complex zinc-lead sulphide carrying values in silver, gold, and copper. This company's smelter was not in commission during 1907.

Some shipments of silver-bearing copper ores were made from the Wellington mine, operated by Mr. Haberman. This mine is developed by a 1,038-foot tunnel. Formerly the ores mined on Telescope Mountain were oxides, but of late only sulphides were produced, until the low metal prices of last fall stopped the shipments. Mr. Haberman then began development work and opened up a new body of carbonate ore 50 feet below the old Sheridan lode.

EAGLE COUNTY.

Production of gold, silver, and associated metals in Eagle County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..............fine ounces..	2,494.26	$51,561	2,594.88	$53,641	+ 100.62	+$2,080
Silver....................do....	94,912	63,591	70,586	46,587	− 24,326	−17,004
Copper ....pounds..	130,233	25,135	14,270	2,854	−115,963	−22,281
Lead ....do....	307,755	17,542	193,690	10,266	−114,065	− 7,276
Zinc.......................do....	1,065,082	64,970	507,949	29,969	−557,133	−35,001
Total....................	....	222,799	....	143,317	....	−79,482

The mineral production of Eagle County in 1907 showed large decreases in all the metals except gold, which made a moderate increase over the production of 1906. The total value fell off more than one-third, and the tonnage was also much smaller than in 1906, but was of a higher grade. The building of the double tracks through the Eagle River Canyon, below Gilman, for the Denver and Rio Grande Railroad, seriously interfered with the shipping of ore from some of the mines and probably accounts for a portion of the lessened output.

Battle Mountain district.—The Bleak House mine shipped silver-bearing lead-zinc ores to the zinc smelters at Pueblo and Canon City. Much smaller quantities of ore were sent to the smelters from the Champion group, the Iron Mask group, and the Pursey Chester group than in 1906; but the Ground Hog, the First Chance, and the Pine Martin groups each made larger productions than in 1906. Other shipping properties about Red Cliff and Gilman include the Cyanide, Evening Star, Little May, Pacific, Whipsaw, and Wyoming mines, all developed by tunnels.

Fulford district.—Only development work was reported from the Fulford section.

Holy Cross district.—A smaller output than in 1906 is reported from the Holy Cross district. Development work was carried on at the Grand Trunk mine, which is now opened by an 80-foot shaft, a 600-foot tunnel, and a 2,500-foot tunnel.

The South Homestake Mining Company was installing a hydraulic plant to handle the stream gravels of this section during the summer of 1908.

FREMONT COUNTY.

During 1907 4 mines in Fremont County produced 162 short tons of ore, containing $6,738 in total metal values, as compared with a production of 1,010 tons of ore, valued at $34,809, in 1906. The gold production increased from $77 to $302, and the quantity of silver from 79 fine ounces in 1906 to 561 fine ounces in 1907. In addition, copper shipments were reported for the first time from 3 districts during 1907, resulting in a county production of 30,330 pounds, valued at $6,066. The zinc output, which furnished most of the values in 1906, dropped off entirely.

The Boma Mining and Milling Company was developing its holdings at Whitehorn, in the Cameron district, and made a small gold output. The Stratton and Mohawk group, in the Badger district, about 9 miles southeast of Salida, made a small shipment of copper ore, bearing gold and silver, to the smelter at Salida. Similar ore, carrying greater copper values, was shipped from the Copper Jack and Jenny mine, near Parkdale. The Isabella mine, in the Current Creek district, the heaviest producer in the county during 1906, was idle in 1907.

Red Gulch district.—Considerable attention has been directed to the new mining camp of Fremont County, at Copperfield, 12 miles north of Cotopaxi. A number of companies, including the Copper Prince Mining and Smelting Company, the Queen Princess Copper Mining Company, and the Red Gulch Gold-Copper Mining and Milling Company, have been doing considerable development work and have made some test shipments of silver-bearing copper ores, in which the ore mineral is chalcocite and the occurrence in a coaly shale. The geology and ore deposits of this district are reviewed by Waldemar Lingdren on pages 170 to 174, inclusive, in Part I of Bulletin No. 340, of the United States Geological Survey.

GILPIN COUNTY.

Production of gold, silver, and associated metals in Gilpin County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.................fine ounces..	53,981.76	$1,115,902	45,399.36	$938,488	−8,582.40	−$177,414
Silver ....do....	242,478	162,460	209,347	138,169	− 33,131	− 24,291
Copper ....pounds..	638,002	123,134	874,060	174,812	+ 236,058	+ 51,678
Lead ....do....	510,791	29,115	611,060	32,386	+ 100,269	+ 3,271
Total	....	1,430,611	....	1,283,855	....	− 146,756

In Gilpin County, during 1907, 84 producing mines shipped 87,887 short tons of ore, with a total value of metal content amounting to $1,283,855, as compared with 90 mines, 114,662 short tons of ore, and $1,430,611 in total value in 1906. The precious-metal values decreased $201,705, and the base-metal values increased $54,949.

Although the gold output decreased $177,414 in value, this metal still forms nearly three-fourths of Gilpin County's total metallic values. The gold won from the different classes of ore decreased uniformly, and, as in 1906, over nine-tenths of the gold was extracted from siliceous ores. The small placer savings were three times as large in 1907, amounting to 83.21 fine ounces, valued at $1,720.

The silver production amounted to 209,347 fine ounces in 1907, valued at $138,169, a decrease of 33,131 fine ounces in quantity and of $24,291 in value. Proportionately, the largest decreases were from copper-lead and lead ores, but the largest actual decrease in quantity was in siliceous ores, which furnished 195,277 fine ounces, or over 93 per cent of the entire silver product of the county.

A small portion of the copper increase was furnished from Gregory district, but the bulk of the gain in output was made from the Russell district, which section also made a gain in the quantity of lead shipped.

The siliceous ores decreased from 111,559 short tons in 1906 to 85,698 tons in 1907. The copper ores increased from 1,449 short tons to 1,880 tons, but this apparent gain was overcome by a decrease of 600 tons in copper-lead ores. The lead ores dropped from 1,054 short tons in 1906 to 309 tons in 1907.

In spite of the lessened output, the mining industry in Gilpin County in 1907 was in a flourishing condition, as is evidenced by the large amount of permanent development work done, especially at the larger mines. Foremost in this was the completion during the year of the work of connecting the Saratoga and Old Town mines with the Newhouse tunnel. The Old Town mine's 2,205-foot inclined shaft is connected by a 4,326-foot lateral which intersects the Newhouse tunnel 14,900 feet from its mouth. A 2,050-foot lateral and a 300-foot upraise also connect the great tunnel with the tenth level of the old workings of the Saratoga mine. Other development includes the Calhoun Tunnel and Mining Company's lateral, which has been driven almost 1,000 feet, and which when completed will be about 3,000 feet long.

Of paramount interest to the mining industry of Gilpin County is the plan now on foot to complete the Newhouse tunnel by advancing the breast until it connects with the old Eureka shaft and drains the Quartz Hill and Gunnell Hill properties, for which a record production of $55,000,000 is claimed, extending over a period of forty years of mining.

Central district.—With the same number of producing mines as in 1906, the output of this district dropped off over two-fifths in 1907. Gold values predominated, with some silver and a little copper and lead. The principal producing mines of this district include the Delmonico, Dean and Castro, Huddleston, Mackey-Burroughs, Nemeha, and Ralls County mines.

Enterprise district.—The Four Mile Gulch Tunnel and Mining Company produced some precious metal-bearing lead ores from the Bryan mine which is developed by a 200-foot shaft and a 1,200-foot tunnel.

Eureka district.—The output of the Eureka district was almost wholly in gold values in 1907, and lacked only $178 of being equal to the total values of 1906. This section has been a rich producer and will undoubtedly add greatly to the county's gold totals again when the Newhouse tunnel unwaters the mines. The Eureka was the largest shipping mine in the section during 1907. The vertical shaft of this mine is to be the terminal of the big tunnel as originally planned. Some production was also made from the properties of the old Gunnell Company.

Gregory district.—Reports for 1907 from the mines of the Gregory district show smaller totals for the number of tons mined and the quantities of gold, silver, and lead, and for the total value of the metals recovered than in 1906, but there was a larger copper product. The gold was less by $13,739, and the silver output decreased 20,003 fine ounces. There were 74,480 more pounds of copper reported in 1907 than in 1906, but the lead output fell short of the production of 1906 by 123,173 pounds. The total value amounted to $279,891, as compared with $298,205 in 1906.

Among the mines, returns were made in 1907 by the Chicago-Carr, the Banzai, the Freedom, the General Loss, the Vasa, the Fifty Gold Mines Corporation, the New National tunnel, the Gower mines, the Aztec Mines Company, and the Ontario-Colorado Company. The production from the Fifty Gold Mines Corporation was interfered with during 1907 by the carrying on of extensive development work. The New National tunnel is 3,000 feet long. The Gower Mines Syndicate, Limited, reported 1,110 feet of development for 1907 on the Running Lode mine, including 200 feet of raises and 800 feet of drifts.

Independence district.—The production from the Independence district, about Rollinsville, in 1907 amounted to just half the output for 1906. The values were almost entirely in gold, with small quantities of silver, copper, and lead. The Perigo mines and the Six Day mines were the main producers, while development work was reported by the Decatur Company.

Nevada district.—A decreased tonnage in 1907 furnished more gold (the principal product), but less quantities of silver, copper, and lead, and a greater total value than in 1906 from the Nevada section. The Alps mine contributed most of this output.

Pine district.—A greatly decreased output was reported from the mines about Apex, but some prospect work was being carried on in this section during the year.

Quartz district.—The 7 shipping mines of the Quartz district in 1907 reported only about one-fourth as much of an output as was made by 9 mines during 1906. The decreases in tonnage and in quantities of metals were uniform, and the total values fell from $79,417 to $20,175. Lead ores were shipped from the Hayseed tunnel and from the Tucker and Anchor mines. Lessees operated the San Juan mine for about a third of the year. Shipments were made also from the Herbert Spencer, Keystone, and Virginia mines.

Russell district.—With 29 out of the 78 producing deep mines of the county, the Russell Gulch section produced about 65 per cent of the tonnage, total values, and quantities of gold, silver, copper, and lead marketed from Gilpin County during 1907. The 56,208 short tons of ore mined contained gold valued at $621,729, 141,710 fine ounces of silver, 567,170 pounds of copper, and 412,396 pounds of lead, or $850,549 in total values. Compared with the production of 1906 the precious-metal values decreased $100,439, but the value of the base-metal output of the district increased $67,527. The quantity of copper nearly doubled, and over 14 times as much lead was reported. This section was the first of the districts of Gilpin County to be served by the Newhouse tunnel, and a considerable portion of the output is now brought to the surface by means of this adit. As mentioned above, the decreased production from this region was caused by some of the larger companies devoting their energies in 1907 to the completion of the connecting laterals between the tunnel and their own workings. The larger producers included the operators of the Aduddell mine, the Druid Mining and Leasing Company, the Town Topics Gold Mining Company, the Jefferson-Calhoun Mining Company, the Pewabic Consolidated Gold Mines Company, the Old Town Consolidated Mining Company, the Saratoga Development Company, and the Cashier Gold Mining and Reduction Company.

GRAND COUNTY.

As in 1906, mining activity in Grand County in 1907 was restricted to development and prospect work. The Seneca group, in the Grand Lake section, reported a 1,100-foot tunnel. Development work placed some gold-silver-lead ores on the dump of the Williams Fork Mining and Milling Company's properties in the La Plata district.

GUNNISON COUNTY.

The mineral production of Gunnison County in 1907 shows a large falling off from the figures of 1906. Seventeen mines produced 18,078 short tons of ore, containing $92,732 in total metal values, as compared with 20 mines, 31,103 tons, and $169,137 in total values in 1906. The gold amounted to 2,978.40 fine ounces, valued at $61,569, a decrease of $25,936. The silver product was less by 43,521 fine ounces than in 1906, and amounted to only 27,277 fine ounces, with a value of $18,003. The copper output was 13,690 pounds, valued at $2,738. The lead totals dropped from 248,737 pounds in 1906 to 120,226 in 1907, and the zinc figures fell from 328,180 pounds to only 68,644 pounds in 1907.

Cochetopa district.—The production came from the Maple Leaf mine at Sillsville, the 1 producer of this section, but was less than that for 1906, owing in a large measure to low prices of metals toward the end of 1907.

Box Canyon district.—A small production of gold and silver was made from the Box Canyon district in 1907. A mill was built during the year by the Abe Lincoln Mining and Milling Company at Bowerman. Some bullion shipments were made from the Camp Bird mine, which is equipped with a 10-stamp mill.

Domingo district.—The Good Hope Mining and Reduction Company's 700-foot vertical shaft near Vulcan, 12 miles southwest of Gunnison, was idle during 1907. The ore is reported as being a refractory sulphide, carrying gold, silver, and copper values.

Elk Mountain district (or Ruby district).—Some fair grade gold-silver ore was shipped to the smelter from the Ruby King mine at Irwin. A 1,000-foot crosscut tunnel was being driven at the Mountain King mine, at Gothic, to cut a lead of gold-silver-copper ore. The Usonia tunnel at Crested Butte is also a long crosscut, driven to develop 3 groups of claims.

Gold Brick district.—The Gold Brick district was the leading gold producing section of the county in 1907, furnishing $48,796 of the value of the county total of $61,569. Over four-fifths of the tonnage and nearly three-fifths of the total metal values were mined in this section. Compared with the production of 1906 there was a decreased tonnage and output of gold, silver, and lead in 1907, and the total value of the metal production of the district was less by $11,265. All of the 4 producing mines made some lead production in addition to that of the precious metal values. The producing mines include the Raymond Consolidated mine, Grand Prize mine, Chief-Buckeye-Bonanza King group, and the Red Jacket mine, all of which have some tunnel developments. Development work was in progress at the Swiss Belle, the Gold Links, and the Golden Islet mines—at the latter two by means of long tunnels. The Carter Mining Company reports the completion of 4,209 feet of a 7,500-foot tunnel. This company planned to erect a 20-stamp plate-amalgamating and concentrating mill during 1908.

Rock Creek district.—A greatly reduced output was made from the Rock Creek and Crystal River section in 1907. A few small test shipments of silver-lead ores constituted the entire production for the year.

Quartz Creek district.—Development work by means of tunnels covers the reports for 1907 of both the N. B. C. Mining Company and the Pandora Mining and Milling Company in the Quartz Creek district.

Tin Cup district.—Much less gold, silver, and lead ore was mined in the Tin Cup district in 1907 than was produced in 1906. The Brunswick Mining and Milling Company was the principal producer in 1907. This property is opened by a 440-foot shaft and 1,500 feet of drifts.

Tomichi district.—As compared with the production of 1906 the Tomichi district made an increased tonnage and output of all 5 metals during 1907. The Morning Star mine shipped values in silver, lead, and zinc, extracted from shallow workings, and silver-lead ore carrying a little gold was mined from the Morning Glim mine. The Great Central Mining and Milling Company was also active in this section.

HINSDALE COUNTY.

Production of gold, silver, and associated metals in Hinsdale County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	1,185.68	$24,510	363.78	$7,520	− 821.90	−$16,990
Silver.....do....	87,940	58,920	50,109	33,072	− 37,831	− 25,848
Copper.....pounds..	63,621	12,279	99,410	19,882	+ 35,789	+ 7,603
Lead.....do....	753,950	42,975	1,204,628	63,845	+450,678	+ 20,870
Zinc.....do....	30,475	1,859	23,034	1,359	− 7,441	− 500
Total.....	.....	140,543	.....	125,678	.....	− 14,865

The metal production from the mines of Hinsdale County was a little smaller in 1907 than in 1906, the total value falling from $140,543 to $125,678. Nine mines reported a tonnage of 10,740 short tons, as compared with 16 mines and 7,086 short tons in 1906. The lead ores amounted to 9,362 tons, or 87 per cent of the total tonnage. In addition, there were 1,303 tons of copper-lead ores, 60 tons of dry or siliceous ores, and 15 tons of copper ore shipped in 1907. A large decrease of output is noted in the precious metals in 1907, which amounted to less than half of that for 1906. The value of gold produced fell off to $7,520, or to less than one-third of that of 1906, and the quantity of silver decreased 43 per cent. On the other hand, the base metal values increased $27,973. The copper product was over one and one-half times as large as in 1906, and the lead output was nearly 60 per cent greater and furnished over half the metal values of the county in 1907.

Galena district.—Six producing mines in the Galena district made a little larger production than was recovered by eight mines in 1906. The tonnage increased over threefold in 1907. A slight gain in copper and a substantial increase in the lead output more than balanced the small decreases in gold, silver, and zinc values. Silver-lead values constituted over four-fifths of the total output from the Galena district. Lead concentrates bearing precious metals were shipped from the mill of the Hidden Treasure Consolidated Mining Company until July 1, 1907, when a cloudburst damaged the water-power plant and prevented operations until the metal prices fell in the latter part of the year, causing the plant to remain idle during that time. The Hanna Mining and Milling Company treated the ores from the Moro mine in a 100-ton concentrating mill, which was also run on custom ores. The company is developing the Moro vein by means of 3 tunnels. Crude silver-lead ore, carrying small gold and copper values, was shipped from the Lellie mines by the Planet Mining and Reduction Company. Shipments were also made from the Excelsior mine, the Highland Chief group, and the Cora-Sulphuret mines. Development work was being carried on at the Dolly Varden, Frank Hough, and Dewey Number 2 mines.

Lake district.—Fewer mines in 1907 than were worked in 1906 produced a little over a third as much ore as was mined in the Lake district in 1906. Less gold and silver was reported, but the copper and lead values more than doubled. The lead values formed nearly one-half of the total value of the mineral product of this district, which decreased from $59,773 in 1906 to $44,446 in 1907.

The production from the Pelican mine was extracted from 2 tunnels, one 600 feet and the other 900 feet long. A large output of copper-lead ores, carrying gold and silver values, was made at the Yellow Medicine mine. Only development work was reported from the Park district for 1907.

JEFFERSON COUNTY.

As in 1906, the production from Jefferson County in 1907 was limited to the Evergreen section and resulted from the marketing, for test purposes, of small quantities of ore extracted in doing development work at the Augusta and Malachite mines. Waldemar Lindgren gives a short description of the geology and ore deposits of this section on pages 167 to 170, inclusive, in the receint "Contributions to Economic Geology," Bulletin No. 340, Part I, of the United States Geological Survey.

LAKE COUNTY.

Production of gold, silver, and associated metals in Lake County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	73,016.31	$1,509,381	51,504.38	$1,064,690	− 21,511.93	− $444,691
Silver..............do....	3,890,338	2,606,526	4,154,913	2,742,243	+ 264,575	+ 135,717
Copper ....pounds..	2,092,735	403,898	2,679,510	535,902	+ 586,775	+ 132,004
Lead ....do....	47,456,964	2,705,047	32,519,796	1,723,549	−14,937,168	− 981,498
Zinc ....do....	71,702,721	4,373,866	37,412,374	2,207,330	−34,290,347	−2,166,536
Total..................	....	11,598,718	....	8,273,714	....	−3,325,004

The production of the mines of Lake County (Leadville), in 1907, as shown by the foregoing table, decreased from the high figures of 1906. The year 1907 opened with everything pointing to a record production, with favorable metal prices; but with the subsequent falling off in prices, the great camp saw the tonnage rapidly decrease and 2 large companies close their mines.

Seventy producing properties mined 631,273 short tons of ore in 1907, as compared with 672,055 tons from 61 mines in 1906. The production fell off 40,782 short tons, and the total value per ton dropped from $17.26 to $13.10.

Reviewing the tonnage, as classified by the metallic content, it will be noted that the dry or siliceous ores increased from 201,878 short tons to 272,728 tons, and there were 1,549 more tons of copper ore shipped than in 1906. The quantities of lead and zinc ores mined in 1906 and 1907 were reduced as follows: Lead ores from 210,404 to 156,799 short tons, zinc ores from 9,039 to 624 short tons, and lead-zinc ores from 250,734 to 199,573 short tons. The total value was reduced $3,325,004, or about three-tenths of the value in 1906. Nearly two-thirds of this decrease, or $2,166,536, was due to smaller zinc shipments.

Lake County produced 22 per cent of the total value of the metal output of the State, and thus ranked second to Teller in total value. With more than a quarter of the total number of tons mined in Colorado in 1907 to its credit, Lake County ranked first in tonnage and in the output of 4 out of 5 metals—silver, copper, lead, and zinc, and was surpassed in the production of gold by only 3 counties—Teller, San Miguel, and Ouray.

Of the State's total output of the different metals this county mined approximately three-eighths of the silver and lead, over 32 per cent of the copper, and almost 71 per cent of the zinc.

The decrease in the gold output amounted to 21,511.93 fine ounces, of which the dry or siliceous ores furnished 20,128.75 fine ounces; the lead ores, 1,692.97 fine ounces; and the lead-zinc ores, 1,094.67 fine ounces. There was a slight increase in placer gold in 1907, and the copper ores supplied 1,373.51 fine ounces more than in 1906. An appreciable percentage of the gold output of Lake County in 1906 was mined as native gold, and was accredited to siliceous ores. That this output was less in 1908 partially accounts for a smaller quantity of gold from an increased tonnage of this class of ore in 1907.

The increase of 264,575 fine ounces of silver in 1907 was due to the greater tonnage of dry or siliceous ores and copper ores. The former furnished 537,696 fine ounces and the copper ores 22,097 fine ounces more than in 1906. Over three-fifths of the silver produced in the county was won from dry or siliceous ores. The lead, zinc, and lead-zinc ores contained 295,297 less fine ounces of silver than in 1906.

The copper output, as reported by the mines, increased over 28 per cent and amounted to 2,679,510 pounds, but the quantity of lead produced decreased nearly a third, and the value fell off nearly a million dollars.

The mines of Lake County shipped only 37,412,374 pounds of zinc in 1907, as compared with 71,702,721 pounds in 1906. This entire decrease was caused by 4 large companies which made reduced shipments during 1907.

The high metal prices prevailing during the latter half of 1906 and the first half of 1907 led to the developing of a very large tonnage of low-grade ore in the properties of the Western Mining Company, in the Downtown section. However, the margin of profit on these ores was so small that when the prices dropped the Midas Company pulled its pumps at the Penrose shaft and consequently much of the Downtown section began to flood. Because of low zinc prices the A. Y. and Minnie mine was closed in September, but this is a dry mine, and work can be resumed whenever the prices warrant such action;

but the cost of again unwatering the Midas properties could only be met by extremely favorable metal prices.

The output from the Iron Silver Mining Company was also greatly curtailed in 1907 because of unsatisfactory metal prices. The properties of this company include the North Moyer, South Moyer, Tucson, and Dome shafts. In 1906 this company mined more metal values than any other company in Colorado.

Previous to the decline in metal prices there was considerable development work in progress over the entire district, and a number of new enterprises were drawing the attention of the mining public. After the fall in prices and the consequent closing of the properties there was a noticeable increase in the leasing system about the county.

The Leadville District Mining and Milling Company put its mill in operation during 1907. The mill is located just north of the Arkansas Valley smelter and handles low-grade sulphide ores from the dumps of the Ibex Mining Company. By the use of jigs and concentrating tables some of the silica is eliminated and a marketable product is made from ores which are otherwise not acceptable to the smelter. The Adams or Wolftone mill handled the sulphide ores from the Wolftone mine. The A. Y. and Minnie mill was closed when the mines ceased producing.

Electric power was more extensively used about the district in 1907 than in 1906, since the transmission lines have been extended from the Leadville Light and Power Company's plant, at the mouth of the Yak tunnel.

MINES REVIEW OF LAKE COUNTY.

The Iron Silver Mining Company mined the greatest tonnage and had also the greatest output in Lake County, though the total values decreased compared with 1906. Likewise, the Ibex Mining Company's production fell off in 1907 because of large gold and zinc decreases and small silver and lead decreases. The copper values increased slightly. This company's Little Johnny mine is the source of much of the gold produced in Lake County each year.

The Yak Company continued its course on approximately the same basis as in 1906. This company is the heaviest producer of silver in Colorado and its extensive developments and holdings make it the foremost enterprise of Leadville.

An increased tonnage and production of gold, silver, copper, lead, and zinc were made from the Western Mining Company's Carbonate Hill mines. About four-fifths of this ore is handled by the Adams mill, near the Wolftone shaft, and the values are principally lead and zinc.

The Morning Star and the Evening Star mines shipped an increased tonnage of oxidized iron ore, carrying silver-lead values. The New Monarch Mining Company continued to make substantial shipments of gold-silver-copper-lead ores, in which the gold values were about equal to those of the other 3 metals.

Development work at the Fanny Rawlings mine exposed a good body of very high-grade gold ore, containing some metallics. The Nisi Prius Consolidated Mining Company shipped silver-lead ores.

LA PLATA COUNTY.

The total value of the metal production from La Plata County in 1907 amounted to $556,022, a gain of $170,333 over the value of the output of 1906. The gold production was 19,954.64 fine ounces, valued at $412,499, an increase of $108,569; and the silver output amounted to 217,432 fine ounces, valued at $143,505, a gain of 95,721 fine ounces. No copper production was reported, and the small lead production dropped to 340 pounds.

Seven mines shipped 7,789 short tons of high-grade siliceous gold ores in 1907, as compared with 7,757 tons from 8 mines in 1906. The production was confined to the California district, northwest of Durango.

The May Day mine continued to be the largest producer of this section, but a much larger production was made from the Valley View mine in 1907 than in 1906. The Empire Gold Mines Company made a shipment from the Small Hopes mine, which is developed by a 240-foot shaft and 2 tunnels, one 600 and the other 1,780 feet long. The Boren Gulch Mining Company has been developing its property by means of tunnels, and in November, 1907, opened up a vein of ore from which it expects to make heavy shipments during 1908. The old Neglected mine has remained idle for the last two years, and only development work was reported by the Bonnie Girl Mining and Milling Company.

Considerable development and prospect work was done throughout the county and small shipments were made from a number of mines.

MINERAL COUNTY.

Production of gold, silver, and associated metals in Mineral County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Decrease.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold .... fine ounces..	7,713.15	$159,445	5,705.64	$117,946	2,007.51	$41,499
Silver .... do....	1,150,318	770,713	870,456	574,501	279,862	196,212
Lead .... pounds..	13,038,333	743,185	10,656,962	564,819	2,381,371	178,366
Zinc .... do....	3,562,737	217,327	1,838,136	108,450	1,724,601	108,877
Total	....	1,890,670	....	1,365,716	....	524,954

In the metallic production for 1907 from Mineral County, as shown in the table, the total values of the different metals made a uniform decrease of one-fourth from the output of 1906, with the single exception of the zinc output, which dropped just one-half, thus causing a decrease of $524,954, or 28 per cent, in the total value of all the metals.

Ten mines produced 104,977 short tons of ore, as against 126,164 tons from 13 mines in 1906. A falling off of nearly $2 per ton is noted in the grade of the ore, which dropped from $14.98 per ton in 1906 to $13.01 per ton in 1907.

Classified according to the metallic content, 74,986 short tons, or nearly three-fourths of the total tonnage of the county, were lead ores. The county ranks next to Lake as a source of this class of ore. The rest of the shipments are classed as dry or siliceous ores.

The carbonate ores, which are shipped crude, decreased from 49,460 tons in 1906 to 37,032 tons in 1907, but the average value per ton increased from $15.30 per ton to $16.78 per ton, and the total values from this class of ore decreased from $756,698 to $621,459. The gold content increased from $9.378 in 1906 to $9,815 in 1907, and the lead product more than doubled, and amounted to 1,650,849 pounds, as compared with 635,545 pounds in 1906, but the silver mined in this ore decreased from 1,061,334 fine ounces to 794,165 fine ounces.

The concentrates from 67,945 short tons of sulphide ores contained gold valued at $108,131, 76,291 fine ounces of silver, 9,006,113 pounds of lead, and 1,838,136 pounds of zinc, with a total value of $744,257. Compared with the corresponding figures for 1906, these totals present the following decreases: 8,759 tons of ore, $41,936 in value of gold, 12,693 fine ounces of silver, 3,396,679 pounds of lead, 1,724,601 pounds of zinc, and $389,715 in total value. The values in the crude sulphide ores decreased from $14.78 per ton in 1906 to $10.95 per ton in 1907.

The year 1907 promised to furnish a record production from Mineral County until the metal prices declined, when the output decreased rapidly, since the lead and silver values predominate in this section.

The following-mentioned companies produced sulphide ores bearing precious metals which were made into lead and zinc concentrates. The production from the Creede United Gold Mines Company (which is concentrated in the Humphrys mill) was less than in 1906, as this company was doing a large amount of development work. At the Amethyst mine a greater tonnage and quantity of silver were mined than in 1906, but the gold, lead, and zinc values fell off so that the total value of the output was considerably less. The mine is opened by a 1,400-foot incline and is equipped with a 100-ton concentrating mill. Electric power was installed by this company during the year. The East Willow Mining Company and the Ridge and Mexico Mining and Milling Company made shipments of concentrates. The Commodore Mining Company and the Del Monte Leasing Company shipped crude silver-lead ore. The Batchelor mine shipped silver ore from a vein opened by a 4,800-foot tunnel. The Corsair and the Alpha mines shipped crude ore. The Monte Carlo Gold and Silver Mining Company also made some production from the Champion mine. Only development work was reported by the Mollie S. Mining Company, the Rio Grande Mining and Milling Company, and by the Ada mine.

MONTEZUMA AND MONTROSE COUNTIES.

Three small mines made test shipments of gold and silver ores from the Mancos section, in Montezuma County, during 1907. The value of the gold product amounted to $535 and the silver to 147 ounces, valued at $97, a total metallic value of $632. The Tomahawk Mines Company spent the year doing development work and reported a 1,200-foot tunnel.

The production from Montrose County consisted of $314 in gold and 9 fine ounces of silver, and was valued at $320.

The La Sal Copper-Silver Mining Company, operating in the La Sal district, mined some good grade silver-bearing copper ore during 1907, but none of it was marketed. The mine was developed by a 375-foot shaft and by 2 tunnels, one 390 feet and the other 1,400 feet long. Lack of transportation facilities retards the exploitation of the mineral resources of this county.

OURAY COUNTY.

Production of gold, silver, and associated metals in Ouray County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold............fine ounces..	47,996.66	$992,179	116,828.00	$2,415,049	+68,831.34	+$1,422,870
Silver..................do....	916,256	613,892	352,519	232,663	− 563,737	− 381,229
Copper ....pounds..	297,741	57,464	410,720	82,144	+ 112,979	+ 24,680
Lead ....do....	5,025,385	286,447	3,496,958	185,339	−1,528,427	− 101,108
Zinc....................do....	10,377	633	30,407	1,794	+ 20,030	+ 1,161
Total..................	....	1,950,615	....	2,916,989	....	+ 966,374

Ouray County showed an increase of nearly a million dollars (or 50 per cent) in the total value of the metallic production as compared with that of 1906, but outside of the Sneffels district the mines of Ouray depend largely upon silver and lead values, and the drop in metal prices caused large decreases in the production of each of these metals during the year, silver falling off more than three-fifths, or 563,737 fine ounces. The lead totals were over 1,500,000 pounds less than in 1906.

Twenty-five producers in 1907 mined 96,662 short tons of ore in Ouray County, as compared with 48.468 tons from 23 mines in 1906, but the average value per ton decreased from $40.25 to $30.18.

The quantity of siliceous or dry ores mined increased from 39,129 tons in 1906 to 91,763 tons in 1907, and the copper-lead ores increased from 34 tons to 2,549 tons; but smaller quantities of copper and lead ores were mined in 1907 than in 1906. The gold won from siliceous or dry ores increased from 43,569.29 fine ounces to 111,198.06 fine ounces, and formed over 95 per cent of the total gold product for 1907. More gold was also won from copper ores, copper-lead ores, and lead-zinc ores, but less from lead ores than in 1906.

Ouray County ranked third to Teller and San Miguel counties as a gold producer in 1907.

Much less silver was mined in all classes of ore in 1907 than in 1906, except from copper-lead and lead-zinc ores, which, however, furnished but a small percentage of the total output.

For the last three years Ouray County has been the center of considerable prospecting and development work, and with the exception of that from a few large established mines the production from most of the mines of the county results from carrying on development work. The United States Geological Survey has recently mapped the geology of the Ouray quadrangle, and during 1907 published it as Folio No. 153 of the Geologic Atlas of the United States.

Sneffels district.—The year 1907 was a very prosperous one for the Sneffels district. With 1 more producing mine than in 1906 the tonnage, gold value, and total metallic values made large increases, due to the increased output at the Camp Bird mine; but less silver and lead were reported from the district than in 1906, largely because of smaller shipments from the Revenue tunnel.

This district produced over 97 per cent of the gold, nearly four-fifths of the silver, approximately three-quarters of the lead, and over 91 per cent of the total values of the metal output of the county in 1907. Ouray County's 3 largest producers are in this district, and the Camp Bird mine produced nearly $600,000 more in value than any other mine in Colorado during 1907. This great mine, with its complete equipment, made a steady production during the year. The mine is connected by an aerial tramway with the 70-stamp, plate-amalgamating, and concentrating mills at Sneffels. The concentrates are shipped to the smelter and the tailings are cyanided.

The Revenue Tunnel mines are operated by lessees.

The Atlas Mining and Milling Company has spent four years in developing its mine, which is equipped with a 10-stamp, plate-amalgamating and concentrating mill. The mill capacity was being doubled during the spring of 1908. A greatly increased production was reported for 1907, consisting principally of gold values, with some silver and lead. Recent developments on the east end of the lode are said to show increasing silver values and decreasing gold content in the ore.

Small shipments, incidental to development work, were made from the Grizzly Bear and the San Pedro mines. Development work was also reported by the Torpedo-Eclipse Mining Company, which is driving a tunnel on a large vein of low-grade gold ore.

Red Mountain district.—The same number of producing mines as in 1906 reported a greatly reduced tonnage and output of gold and silver in 1907, but the increased lead and copper content raised the total value of the metallic product of this district from $93,003 to $142,925. Nine-tenths of the copper output of the county were made from the Genesee and the Yankee Girl mines. The Genesee is developed by a 5,300-foot tunnel and the Yankee Girl by an old shaft 950 feet deep, but is worked through the Joker tunnel, which is 4,900 feet long.

Lessees made some small shipments of ore from the National Belle mine, which is developed by a 500-foot shaft and by 4 tunnels ranging between 200 and 300 feet in length. The San Antonio Mining Company was one of the principal producers of this section during 1907, shipping a good grade of copper-lead ore, carrying gold and silver values, from a 200-foot shaft, developed on 2 levels. Shipments of silver-bearing copper ores were made by the Mono-Baltic Mining and Smelting Company, which operated some of the properties of the Continental Smelting and Refining Company in addition to its own mines. The latter company was idle throughout the year.

A production was made by the Gold Lion Mines Company, which was driving a lower crosscut tunnel. The Continental-American Gold Mining and Milling Company and the Treasury Tunnel Mines Corporation each reported shipments and tunnel development work.

Uncompahgre district.—The value of the production of 1907 from the section about Ouray was less than that of 1906. The gold returns were over two and one-half times as large, but there was less than one-quarter as much silver. There was about three-fifths as much lead produced as in 1906, and a little more than one-half as much copper was mined.

The Jonathan mine was largely responsible for the increased gold output. Some silver ore was mined by the Neodesha mine, and the American Gold Mining Company reported an output from the American Nettie mine. Shipments from the Newsboy mine carried silver values principally, with some lead and gold. But little ore was taken from the Mineral Farm mine, which was being developed, but the mill was operated in an experimental way on ore from the dump during a portion of the year. Shipments were also made from the John L., Memphis, Bright Diamond, and Khedive mines. The Thistledown mine was developed by a 3,000-foot tunnel, and the Camp Bird Extension mine by a 2,900-foot tunnel.

PARK COUNTY.

Production of gold, silver, and associated metals in Park County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.................fine ounces..	19,110.54	$395,050	24,826.82	$513,216	+5,716.28	+$118,166
Silver.......................do....	144,815	97,026	111,215	73,402	− 33,600	− 23,624
Copper ....pounds..	14,399	2,779	....	....	− 14,399	− 2,779
Lead ....do....	966,193	55,073	1,062,732	56,325	+ 96,539	+ 1,252
Zinc ....do....	....	....	333,407	19,671	+ 333,407	+ 19,671
Total..........................	....	549,928	....	662,614	....	+ 112,686

Park County during 1907 produced 12,661 short tons of ore, as compared with a production of 10,072 tons in 1906. The value of the gold output amounted to $513,216, and the lead production amounted to 1,062,732 pounds, but the silver was only 111,215 fine ounces, and showed a decrease of over 23 per cent as compared with the output of 1906. The mines reported no copper production, but zinc shipments amounted to 333,407 pounds, and more than made up for the decreased copper values.

The total value of the metallic production of the mines of Park County was somewhat greater than in 1906, and amounted to $662,614. The average value per ton dropped from $54.60 in 1906 to $51.78 in 1907. The placer yield was $6,953 in gold, as compared with $10,084 in gold in 1906.

Buckskin district.—Much more ore was mined in the Buckskin district than was produced in 1906, and the gold output more than doubled. Much less silver, copper, and lead was obtained than in 1906, and the total value decreased $1,536.

A considerable production was made by the Paris mine, which is developed by 2 tunnels connecting with shafts to the surface. This company also operated a 20-stamp plate-amalgamating and concentrating mill. Small shipments were made by the Sir Walter Mining Company and by the Golden Wave Mining Company.

Consolidated Montgomery district.—The production from this district was smaller than in 1906. Small shipments of silver ores, carrying but little gold, were reported from the Morning Star, the Pinnacle, and the Russia mines. The 2 last-named mines were developed by tunnels, and the production from each resulted from doing development work. As these mines are under one management, the Pinnacle mine will in the future be operated through tunnels from the Russia, in which there are about 5,000 feet of workings.

Halls Valley district.—A shipment of silver-lead ore was made from the Rainbow mine at Halls Valley. This section (just south of the Argentine district of Clear Creek County) has been practically abandoned for over 25 years.

Horseshoe district.—Probably the most noteworthy feature of the progress of the mining industry in Park County during 1907 was the reopening of the old Hilltop and Last Chance mines in the Horseshoe section. These properties were worked years ago for the lead-carbonate ores, and the present zinc shipments are of carbonates, thus differing from the zinc product of Leadville, just over the range, which is wholly from sulphide ores. The ores at the Hilltop mine are reported to occur as a lead-zinc replacement in limestone. A greatly increased output is expected from this mine in 1908. At the Last Chance mine a shipment was made from the dumps, which averaged over 40 per cent in zinc. The mine was expected to be on a shipping basis by the middle of 1908.

Mosquito district.—As in 1906, this district furnished over 95 per cent of the metal production from deep mines in the county. Six mines produced 11,444 short tons of ore, as against 9,594 tons from 4 mines in 1906. The gold output of the district was somewhat larger than in 1906. More lead was reported, and the total value of the metals increased $111,619, but less silver was mined in 1907.

The London mine remains the foremost producer of gold and lead of the county. The Alma Mining Company reported shipments from the Hock Hocking mine, the largest silver producer of the county. Shipments were also reported by the Butte Mining Company, the Kennebec Mining Company, and the London Fault Mining Company, the latter concern operating the New York mine.

Tarryall district.—The Apex Copper Company, operating at Hayman, reported a trial shipment during 1907. The mine is developed by a 250-foot shaft and 400 feet of drifts. A small amount of gold was won from the placers of this section during 1907, but most of the placer output was mined about Alma and Fairplay.

PITKIN COUNTY.

Production of gold, silver, and associated metals in Pitkin County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold............fine ounces..	56.69	$1,172	28.01	$579	− 28.68	− $593
Silver..................do....	2,131,374	1,428,021	1,719,446	1,134,834	− 411,928	−293,187
Copper ....pounds..	....	....	10,735	2,147	+ 10,735	+ 2,147
Lead..................do....	17,951,674	1,023,245	12,235,230	648,467	−5,716,444	−374,778
Zinc ....do....	3,673,755	224,099	5,799,746	342,185	+2,125,991	+118,086
Total....................	....	2,676,537	....	2,128,212	....	−548,325

Reports received from the producing mines of Pitkin County show that less gold, silver, and lead was produced, but that greater quantities of copper and zinc were marketed during 1907 than in 1906. Twenty producing mines, or 7 less than in 1906, handled 183,836 short tons of ore, averaging in value $11.58 per ton, as compared with 203,400 tons, worth $13.11 per ton in 1906.

The gold output of this county is of little importance and is won from the outlying districts. Pitkin County still ranks second only to Lake County in the production of silver and zinc, but during 1907 was surpassed by San Juan County as a lead producer. This section, probably more than any other in the State of Colorado, depends upon favorable metal prices, since, as stated above, the gold output is of little consequence in the total value of the county's metallic output.

In 1907, 988,241 fine ounces of silver were obtained from dry ores, most of which carried some lead, but not enough to class the ores as lead ores. A large part of these ores contain galena in limestone gangue; they averaged 19.76 ounces of silver to the ton, as against 16.5 ounces per ton in 1906. Lead-zinc ores furnished 543,262 fine ounces of silver, or 31 per cent of the silver output, and averaged 4.4 fine ounces per ton crude, as compared with 7 ounces per ton in 1906. Lead ores carried 176,740 fine ounces, and the content per ton dropped from 18.2 ounces in 1906 to 17.4 ounces in 1907. In addition, a small quantity of silver was recovered from copper-lead ores. Most of the county's production is mined in the Roaring Fork district, about Aspen, the mining center; but the outside districts, south and southeast of Aspen, report an increased amount of development and prospect work.

Roaring Fork district.—The Smuggler Mining Company's operations resulted in about the same production as in 1906.

The Durant Mining Company, operated by the same interests as the Smuggler, reported a considerably increased output for 1907 and a greater tonnage and more silver than were produced in 1906, but less lead was shipped from the Aspen mine, one of the company's holdings.

The Percy-La Salle Mining and Power Company, operating on West Aspen Mountain, reported a reduced production from both company and lessees' operations.

The Aspen Fraction, Ingersoll, Della S., and Franklin reported production. Simple silver ores were shipped from the first 2, and siliceous silver ores, carrying but little lead, were shipped from the last 2 mines.

The Bonnybell, Millinee, Mineral Farm, and Spar Consolidated shipped siliceous silver ores, while silver-bearing lead ores were produced at the Bushwhacker and the Monongahela mines. At the Argentum-Juniata were mined siliceous silver ores carrying small lead values. Most of the mines of the Roaring Fork district are opened by long tunnels; the Smuggler and the Durant mines are besides developed by shafts 900 feet deep, from which a very large quantity of water is pumped.

Lincoln district.—A slightly increased output was reported from the Ruby Mining and Development Company, operating in the extreme southeast corner of the county. Operations were confined to the summer months, as during the winter months it is difficult to keep the roads open. The shipments of 1907 were from the Ruby

No. 4 mine, and consisted of silver-bearing copper-lead ores, carrying but small gold values.

Columbia district.—The Tam O'Shanter and Montezuma Mining and Development Company developed its mine and erected a water-power plant, concentrating mill, and other surface improvements, including an aerial tramway from the mine to the mill, 1⅛ miles in length.

ROUTT COUNTY.

The value of the metal production of Routt County in 1907 amounted to $5,292, a decrease of $1,687 from the output of 1906. The gold product amounted to 242.32 fine ounces, valued at $5,009, as compared with 336.24 ounces, valued at $6,951, in 1906. The silver product increased from 42 fine ounces, valued at $28, in 1906 to 429 ounces, valued at $283, in 1907.

Hahn's Peak district.—A trial shipment of 3 tons of silver ore was made from the Hahn's Peak district, by the Hahn's Peak Gold Mining and Milling Company. This company has been working continuously since 1905 and reports about 2,000 tons of good milling ore, which is being stored for a prospective mill. The development work includes several tunnels, the longest being 835 feet. The placer cleanups in this section were approximately 6 times as large as in 1906.

Larger savings were made in 1907 by lessees on the Hahn's Peak and Elk River Canal and Placer Mining Company's holdings and by the new dredge of the Iowa Hahn's Peak Gold Mining Company than in 1906. An insufficient supply of coal hindered the operation of this dredge during the season of 1907. Development work at the Exchequer mine has been in progress for four years and includes a 200-foot shaft and 2 tunnels, one 250 feet and the other 750 feet long.

Four Mile district.—Sluicing operations on the Nelson Bar placer, in the Four Mile section, south of Baggs, Wyo., resulted, during 1907, in double the savings of 1906.

Lay district.—The output from the Lay district in 1907 was less than that of 1906. The Blevin's dredge was sold to the Colorado Mines and Water Company. The Housel-Melvin Mining Company made a cleanup from hydraulic operations, and reported that a dredge would be installed during the season of 1908. The dredge season in this section usually extends from about April 1 to October 15, when freezing interrupts the work.

Hoyt S. Gale has described the placer deposits near Lay, Routt County, Colo., on pages 84 to 95, inclusive, Bulletin No. 340, United States Geological Survey.

SAGUACHE COUNTY.

Four mines in 1907 produced 170 short tons of ore, carrying 31.40 fine ounces of gold, valued at $649; 6,194 fine ounces of silver, valued at $4,088; 22,528 pounds of lead, valued at $1,194, and 1,260 pounds of copper, valued at $252—a total value of $6,183. Compared with the production of 1906, this represents a decrease of 3 mines, 829 tons of ore, $6,979 in value of gold, 26,613 pounds of lead, and $4,740 in total value; but the silver increased 5,457 fine ounces, and no copper was reported by the mines in 1906.

The large decrease in tonnage and gold output was due to the idleness of the mines in the Baca Grant district, about Crestone, and smaller shipments of lead ores bearing gold, silver, and copper from the Blake district account for the falling off in the lead output.

In the Blake district, about Villa Grove, the Mountain Lion mine is developed by 3 inclined shafts, and a crosscut tunnel is being driven to cut the veins at a depth of 400 feet. The M. E. G. mine is opened by a 130-foot crosscut tunnel.

Shipments of assorted silver ore were made from the Esperanza mine, in the Crystal Hill district, in the southwestern corner of the county, near Del Norte. This mine is developed by a 200-foot vertical shaft.

SAN JUAN COUNTY.

Production of gold, silver, and associated metals in San Juan County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold ....fine ounces..	43,545.96	$900,175	46,814.03	$967,732	+ 3,268.07	+$67,557
Silver ....do......	690,076	462,351	1,175,176	775,616	+ 485,100	+313,265
Copper ....pounds..	1,549,663	299,085	2,450,280	490,056	+ 900,617	+190,971
Lead ....do......	4,515,317	257,373	12,483,507	661,626	+7,968,190	+404,253
Zinc..................do......	584,476	35,653	237,677	14,023	− 346,799	− 21,630
Total..................	....	1,954,637	....	2,909,053	....	+954,416

The total value of the metallic product from the various mines and mills of San Juan County was almost a million dollars in excess of the value of the output of 1906, and amounted to $2,909,053 in 1907, as compared with $1,954,637 in 1906. There was an increased tonnage and also an increased production of all the metals, except zinc, which decreased to less than one-half of the production of 1906.

The gold output increased 3,268.07 fine ounces in quantity and $67,557 in value. Of this gain in quantity, 3,428.02 fine ounces were from dry or siliceous ores, 856.79 ounces from lead ores, and 447.27 ounces from lead-zinc ores. Copper ores from San Juan County mines furnished 1,464.01 fine ounces less gold than in 1906.

The quantity of silver mined in the county in 1907 was much larger than the output of 1906. The gain in value amounted to $313,265, or approximately one-third of the total increase of values from all of the metals over those of 1906. Nearly twice as much silver was won in all classes of ore except in copper ores, in which the silver product decreased from 179,797 fine ounces in 1906 to 69,168 ounces in 1907. Of the total silver output of the county, 646,612 fine ounces, or 55 per cent, were from dry or siliceous ores; 407,567 ounces, or nearly 35 per cent, were from lead ores; and the remainder, or 10 per cent, was furnished by copper ores and copper-lead ores.

Tere were 2,450,280 pounds of copper reported from the mines of San Juan County in 1907, as compared with 1,549,663 pounds in 1906—a gain of 900,617 ounds, or nearly 37 per cent. This large increase is chiefly due to the operations at the new Silver Lake concentrating mill on ores from the Aspen and Silver Lake mines.

San Juan County almost equaled Lake County in 1907 as a copper producer. The lead production made the largest increases of all metal outputs, both in quantity and in value. The increase from 4,515,317 pounds in 1906, to 12,483,507 pounds, coupled with a decreased production of lead in Pitkin County in 1907, makes San Juan rank second only to Lake County as a producer of lead. The Iowa, the Grand Mogul, the Aspen, and the Silver Lake mines contributed largely to the greater lead output. The zinc production fell off over one-half of the output of 1906 and was about equal to that of 1905.

Twenty-seven mines reported shipments aggregating 235,639 short tons, in 1907, which averaged $12.35 per ton, crude, as compared with 196,438 short tons averaging $9.95 per ton, from 26 mines, in 1906. In 1907 the siliceous ores formed nearly 80 per cent of the total tonnage, as compared with 85 per cent in 1906, and the lead ores increased from 2,309 tons in 1906 to 35,201 tons in 1907, and constituted 15 per cent of the total output. There were smaller quantities of copper ores and lead-zinc ores than in 1906, but a larger tonnage of copper-lead ores was mined during 1907.

The misfortunes which occurred in 1906 were not repeated in 1907. The mining industry was very prosperous until the metal prices dropped, when, as in the other counties where silver and the base metals constitute a goodly portion of the values, some of the companies curtailed their shipments or temporarily closed down. Among these latter was the Ross Mining and Milling Company, which ceased work at its 125-ton copper-matting plant. Furthermore, a number of the large enterprises of the county were still in the development stage, and in some cases these were closed for the time being by the money stringency.

Animas district.—A great tonnage of copper-lead ores bearing precious metals was mined at the Aspen mine, and all but a small percentage was concentrated in one section of the new Silver Lake Mines mill. The mine is opened by crosscut tunnels. The Garfield Smelting Company likewise made a much larger production from its Silver Lake mines, all of which was concentrated in its new 450-ton mill, which was placed in commission early in 1907. The mine developments include several miles of tunnels, shafts, drifts, and raises.

A large tonnage of lead ore, carrying some silver and gold values, was mined and milled by the Iowa Gold Mining and Milling Company. The capacity of this company's concentrating mill is 150 tons. Less gold, but more silver, copper, and lead, was produced than in 1906 by the Old Hundred Mining Company, operating the Midland Mining Company, the Hawkeye Consolidated Mining Company, and the Old Hundred, and the Neigold claims.

The Ross Mining and Milling Company's smelter operations included the handling of considerable copper ore from the Red Mountain section, but ore was also obtained from their own properties in this county, which included the Champion, Silver Wing, St. Paul, and Galta Boy.

Production was reported by the Hamlet Mining and Milling Company. The ore carries some values in all 5 metals and is concentrated in the company's 70-ton mill. Shipments were also made by the Esmeralda, Green Mountain, Joe and John, Lookout, Mountaineer, and North Star mines. In addition, the Auburn Consolidated

Gold Mining Company, with a 1,200-foot tunnel, and the Mountain Queen Mining and Milling Company, with a 400-foot shaft and a 2,000-foot tunnel, reported active development work during 1907. The Peerless San Juan Mining Company was tunneling and drifting, and the ore was stored on the dump. A 300-ton concentrating mill was being erected at the Henrietta mine. The Silverton Mining Company's plans include the remodeling of its mill into a regular concentrating plant.

King Solomon district.—From the King Solomon section shipments were made from the Dives and the Shenandoah No. 3 mines.

Eureka district.—The Gold King Consolidated Mines Company and the Gold Prince Mines Company each made a large production, but the big Gold Prince mill at Animas Forks was not worked at full capacity during 1907.

Production was also continued by the Sunnyside and Grand Mogul mines in this district. The Hercules mine is developed by 3 tunnels, respectively 2,600 feet, 1,800 feet, and 1,920 feet in length, and by 2 shafts sunk from tunnel levels, and is equipped with a 150-ton amalgamating and concentrating mill. Gold formed the chief value in the ore, but it also contained some silver, copper, and lead values.

The Eureka Exploration Company made shipments of crude copper ore, carrying silver values, from the Silver Wing mine to the smelter at Silverton. The Bonanza King mine reported a small production.

Considerable development work was in progress during 1907 in the Eureka district, and the Astor Mining Company, the Consolidated Eureka Mining and Tunnel Company, and the Tom Moore Mining Company were all actively engaged in opening up their properties. The last concern has acquired a large number of claims, and reports that it has developed bodies of milling ore, and that a 200-ton mill is to be erected.

SAN MIGUEL COUNTY.

Production of gold, silver, and associated metals in San Miguel County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	118,411.84	$2,447,790	119,366.09	$2,467,516	+ 954.25	+$19,726
Silver..................do....	1,672,522	1,120,590	1,438,299	949,277	− 234,223	−171,313
Copper ....pounds..	70,725	13,650	14,905	2,981	− 55,820	− 10,669
Lead ....do....	7,158,189	408,017	5,274,641	279,556	−1,883,548	−128,461
Total..................	....	3,990,047	....	3,699,330	....	−290,717

The metal output from San Miguel County in 1907 fell short of the record production of 1906 by $290,717. The mine reports showed decreases in the quantities of all the metals except gold, which made the slight advance of $19,726. The silver production decreased in quantity 234,223 fine ounces, or 14 per cent. The copper output was much smaller than in 1906, and a falling off of 1,883,548 pounds is noted in the lead output for 1907.

With 21 producing mines (the same number as in 1906), the total tonnage increased from 386,735 short tons in 1906 to 407,491 tons in

1907, but the total value per ton, crude, was only $9.08, as compared with $10.31 in 1906 and with $9.58 in 1905.

The siliceous or dry ores amounted to 406,650 short tons, or more than 99 per cent of the entire tonnage, and were the source of practically the entire gold and silver product, as much smaller quantities of precious metals were recovered from lead ores and from placer workings in 1907. Compared with the other counties of Colorado in 1907, San Miguel County ranked second only to Teller County as a gold producer, and third to Teller and Lake counties in the total tonnage mined and in the total value of the metallic output, and third to Lake and Pitkin counties as a silver producer.

Upper San Miguel district.—The production in this district in 1907 was 400,538 tons of ore and $2,385,265 in gold, 1,417,238 fine ounces of silver, 7,565 pounds of copper, and 4,936,170 pounds of lead. The total value of the production was $3,583,772. Three large mines of this district furnished over nine-tenths of the county's total production in 1907.

The Tom Boy Gold Mines Company (Limited) operating the Argentine mine, reported an increased tonnage and content of gold and copper and a greater total value, but the lead and silver values were less than in 1906. The Smuggler-Union Mining Company also reported an increased production, largely from the operations of leases.

At the Liberty Bell mine and mill a greater tonnage of somewhat lower grade ore was mined, and much development work was accomplished by means of a lower tunnel, which is 2,487 feet long, and a 964-foot upraise to the old workings. At the Argentine and the Liberty Bell mines the values are chiefly in gold, but at the Smuggler-Union mine the values are about equally divided between gold and silver.

Continued production was reported from the Alta mine and the Columbia-Menona, which has been included in a consolidation with other properties, by the Mines Finance Company. The Japan-Flora Mines and Tunnel Company also reported production from the Japan mines, which were developed by a 725-foot shaft connecting with a 3,000-foot tunnel.

During 1907 the Black Bear Mining Company built a 612-foot aerial tramway from the mine to the mill and a 5,895-foot tramway from the mill to the railroad at Pandora.

The Mayflower Gold Mining and Reduction Company also did considerable construction work during 1907, including remodeling of the old Alleghany mill, near the Liberty Bell mill, and connecting it with the mine in Gray's Basin by a 2½-mile aerial tramway. The difference in elevation is 3,060 feet, and one span over Bridal Veil Creek is 1,600 feet in length. The Ella Gold Mining Company, the Contention Mining Company, and the Gold King Mining Company reported shipments from this district in 1907.

Iron Springs district.—The value of the metallic product of the Iron Springs district was $61,071 in 1907, and came from 6,597 tons of ore yielding gold, silver, copper, and lead. An increased tonnage and increased gold output were reported, but the silver and lead totals were greatly decreased.

The Buckeye Mining and Leasing Company reported production from the Butterfly-Terrible mine, which is opened by a 3,200-foot tunnel and equipped with a 20-stamp amalgamating and concentrating mill. Shipments of high-grade silver-lead ore were reported from the Carbonero mine. Other producers included the Suffolk, New Dominion, Favorite, and Badger Boy mines.

Lower San Miguel district.—This district, in the vicinity of Sawpit, was the center of greatly increased activity, and 6 mines reported shipments in 1907, principally lead ores bearing precious metals, as compared with reports from only 1 producer in 1906.

Mount Wilson district.—Silver-lead ore, carrying small gold values, was sent from the Morning Star mine, which was developed by 3 tunnels on the vein.

SUMMIT COUNTY.

Production of gold, silver, and associated metals in Summit County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold .... fine ounces..	6,761.52	$139,773	5,156.29	$106,590	−1,605.23	−$33,183
Silver .... do....	107,752	72,194	125,847	83,059	+ 18,095	+ 10,865
Copper .... pounds..	27,120	5,234	21,865	4,373	− 5,255	− 861
Lead .... do....	1,301,912	74,209	1,915,133	101,502	+ 613,221	+ 27,293
Zinc .... do....	2,942,983	179,522	3,026,627	178,571	+ 83,644	− 951
Total	....	470,932	....	474,095	....	+ 3,163

The gain of $3,163 in the value of the metallic output of Summit County, as compared with that of 1906, was brought about by substantial increases in silver and lead values, which more than balanced the diminished gold and copper productions.

The decrease in gold of $33,183 was caused by much smaller returns from placer mines and from siliceous or dry ores, as the lead and zinc ores furnished more gold in 1907 than in 1906. Likewise, less silver was mined in siliceous or dry ores and in lead-zinc ores, but increased quantities obtained from lead ores and zinc ores resulted in an increase of 18,095 fine ounces over the production of 1906.

The decrease in copper was due to smaller shipments from the Snake River, or Montezuma district. The lead product was nearly one-half as large again as in 1906, because of increased lead shipments from the Bevan district. The zinc output shows an increase, but because of the lower prices in 1907 than in 1906 the value decreased $951.

The same number of mines (39) as in 1906 produced greater quantities of lead ores, zinc ores, lead-zinc and copper-lead ores, but much smaller quantities of dry or siliceous ores, with a resulting total tonnage of 25,127 short tons, or 8,923 tons less than in 1906.

Breckenridge section (including Bevan, Minnesota, and Union mining districts).—In the Bevan district a decreased tonnage and less gold were mined, but the quantities of silver, copper, lead, and zinc were greater than in 1906. The Wellington mine was the foremost producer of this section, but shipments were also made from the Dunkin group, the Sallie Barber, the Truax, and the Little Sallie Barber mines. The total value of the production from 7 mines was $175,201 in 1907.

Minnesota district.—From the mines of this district a decreased tonnage and smaller quantities of gold, silver, and lead were reported; the total value was less than half as large as in 1906.

The Blue Flag Gold Mining Company began producing lead ores bearing precious metals from the Laurium group in October, 1907. The developments include a 1,250-foot tunnel and crosscuts, and the ore is concentrated in a 50-ton mill. A small yield of gold resulted from development work at the Senator and the Atlantic mines. The latter mine is in the Pollock section. Small productions were also made by the Little Tommie and the Silver King mines.

In September, 1907, the Colorado Gold Dredging Company acquired extensive holdings of stream and bench gravels and began the installation of 2 large dredges whose output will materially increase the placer production of Summit County during 1908. The Reliance dredge reports a successful season's operations in 1907.

Union district.—A decrease in tonnage, and more gold and silver, but less lead and zinc, were mined in the Union district in 1907 than in 1906. The shipping mines included the Country Boy, Jessie, Gold Dust-Puzzle mines, and the Germania group.

Montezuma district (or Snake River).—The output from this section was only about one-third as large as in 1906, as the larger companies confined their efforts to development work, and many small properties also reported development work. The active properties included the Bullion, Fisherman, Rothschild, Pennsylvania, Quail, Silver Wing, Clarion, Boer, Queen of the West, and Little Jumbo mines.

Consolidated Ten Mile district.—An increased tonnage and production of all 5 metals is reported from the mines of this district, which includes the 3 camps, Frisco, Kokomo, and Robinson.

The precious-metal output was double the production for 1906 and amounted to $32,478 in gold and 70,645 fine ounces of silver. In addition, there were 450,925 pounds of lead, 807,187 pounds of zinc, and 20,270 pounds of copper mined in the district. The Kokomo section was the chief source of the production of 1907, but an increased output was made by the Excelsior mine, near Frisco. Operations were begun at Robinson late in 1907.

A consolidation was effected during 1907 whereby the Kimberly-Wilfley Mining Company acquired the Wilfley, Kimberly, and Summit interests, formerly operated by the Summit Mining and Smelting Company.

Other producing mines included the Selma group, Michigan group, Utoff tunnel, and the properties of the Delaware Gold Mining Company.

TELLER COUNTY.

Production of gold, silver, and copper in Teller County, Colo., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.........fine ounces..	689,500.73	$14,258,245	527,949.61	$10,913,687	−161,551.12	−$3,339,558
Silver...............do....	49,527	33,183	60,397	39,862	+ 10,870	+ 6,679
Copper ....pounds..	1,280	247	....	....	− 1,280	− 247
Total................	....	14,286,675	....	10,953,549	....	− 3,333,126

The value of the metals mined during 1907 in Teller County amunted to $10,953,549, or $3,333,126 less than in 1906. The gold production from the mines decreased in value $3,339,558 and amounted to $10,913,687.

A slight gain was made in the silver output. but no copper was reported.

Eighty-three mines reported a production of 451,082 short tons of ore, carrying an average value of $24.28 per ton, as compared with 702,069 short tons, averaging $20.35 per ton, from 105 mines in 1906.

The figures of production from the mines of Cripple Creek were lower in 1907 than for any year since 1897, but this was partially due to a decreased mill capacity after the destruction by fire of the Golden Cycle mill, August 7. During the early months of 1907 the operators were handicapped by a shortage of good miners, but after the decline in the values of silver and the base metals many miners returned to Cripple Creek from the different silver-lead camps of the State, and labor was plentiful at the end of 1907. The year was free from labor disturbances, except when an unsuccessful attempt was made to abolish the card system of the Mine Owners' Association.

The leasing system was still further extended, a number of companies, including the El Paso Consolidated Mining and Milling Company, the Anchoria-Leland Mining and Milling Company, the Midget Gold Mining Company, and the Ethel Louise Gold Mining Company, opening all or a portion of their properties to lessees.

The year 1907 witnessed the starting of the great Roosevelt tunnel, which, when completed, is expected to furnish drainage for the larger part of the district for a depth of 770 feet below the El Paso tunnel. The work did not progress as rapidly during 1907 as planned, and the management of the enterprise was changed a number of times. More satisfactory progress was being made during the first half of 1908. Approximately 1,200 feet had been driven by January 1, 1908. The tunnel is being driven through Pikes Peak granite, which is very hard to break.

A review of the milling operations of 1907 presents several interesting changes. The Golden Cycle mill at Colorado City was operated from February until August 7, when a fire (supposed to have started from an explosion of accumulated coal dust in one of the roaster fire boxes) destroyed the sampling mill, machine shop, boiler house, and roaster building. Reconstruction work was commenced immediately, and early in December the plant again began milling ore. The ores are roasted and cyanided at this mill, while at the large plants of the United States Reduction and Refining Company and the Portland Gold Mining Company (also at Colorado City) the ores are roasted and chlorinated, and the tailings are cyanided.

The following cyanide mills are located in the Cripple Creek district. The Stratton's Independence (Limited), was erecting a mill at the mine at Victor to treat the low-grade ore, as well as ore from the great dump, by roasting and cyaniding. It is claimed that ore averaging less than $3 in value to the ton will be treated at a profit when the mill is in running order. A very successful year is claimed for the Isabella mill, which was erected during 1906. The Ironclad Milling Company operated its mill during 1907 on highly oxidized ores, said to carry less than $2.50 in value per ton. Electric power is utilized in this plant. During 1907 the Phoenix or large Ironclad mill was operated about one-half the time, and the Jo Dandy Company had a mill in operation for about three months. The Blue Flag and the Wishbone mills were both leaching ore toward the end of the year. The W. P. H. mill was started on ores from the Jerry Johnson dump early in 1908.

With the destruction of the Golden Cycle mill in August, 1907, much newspaper comment was made to the effect that the mines of the district must necessarily curtail their output of lower grades of ore because of the ruling freight and treatment charges, but in October the United States Reduction and Refining Company announced a reduction in treatment charges, equivalent to $1 per ton on all classes of ore. On December 26 another reduction was made, ranging from 75 cents per ton on one-half ounce ore to $2 per ton on higher grade ores. In February, 1908, the Golden Cycle Company cut these rates approximately from 25 to 50 cents per ton for long-time contracts. This reduction was immediately met with a cut, ranging from 50 cents to $1 per ton by the United States Reduction and Refining Company, but as an open schedule, only. Thus, from October 1, 1907, to March 1, 1908, the charges on ores carrying values up to $10 per ton had been reduced from $6.25 to $3.50 per ton.

Lower freight and treatment costs are of the greatest importance to the mines of Cripple Creek, since in the future it appears that much of the production will be derived from the lower grade ores. Much high-grade ore will be shipped as usual, but it is certain that extensive reserves of lower grade ores have been developed during the past years.

There were 24 mines in the Cripple Creek district which produced over $100,000 in 1906, but this number was reduced to 20 in 1907. In comparing the yield for the two years, of 27 different mines producing in one or both years ore valued at $100,000 or over, 19 of the above-mentioned mines made decreased productions, while 8 reported larger shipments. Nine of the larger properties made a decreased gold output of $3,692,718, as compared with that of 1906.

The Portland Mining Company's annual report for 1907 shows a production of 79,960 short tons of ore, with a gross value of $1,600,950, a decrease of 23,654 tons and of $331,133 from the 1906 output. This production includes 70,392 tons of ore, averaging in value $21.75 to the ton, and 9,567 tons taken out in course of development, which averaged only $7.25 to the ton. The mine's total production from April 1, 1894, to December 31, 1907, amounts to 855,070 tons, valued at $26,635,362, of which $7,627,080 have been paid in dividends. The smaller production from the Portland mine in 1907 was caused by a shortage of labor during part of the year and because it was found necessary to spend considerable time in making old stopes secure so that the remaining ore might be extracted. The printed annual report shows that during the first ten years of the mine's history large stopes were timbered and not filled with waste, and now the decaying timbers make it necessary to fill these stopes, so that much medium-grade ore which was left in the early workings can be extracted. During 1907, 8,378 feet of development work was done, making a total of 206,830 feet, or 39 miles and 910 feet, of development work up to January 1, 1908.

The Golden Cycle Mining Company was the only other concern in the Cripple Creek district to produce over $1,000,000 in 1907. According to its printed report there were 67,397 tons of ore mined, which averaged in value $21.02 per ton, and the main workings were closed for two months because of the fire at the mill.

The Vindicator Consolidated Gold Mining Company's annual report states that 1907 was the most successful year in the history of the company. Including lease shipments, there were 23,615 tons of ore, valued at $920,896, or averaging in value $39 per ton. The experimental mill tests carried on in the old Lillie shaft house were not deemed satisfactory enough to warrant the building of a mill to handle the company ore, especially since the treatment rates were reduced. In February a fire occurred which disabled the machinery at the Hull City shaft, necessitating a suspension of underground operations. During the year 11,733 feet of development work was done, making a total of 134,889 feet, or 25.546 miles, of underground workings done to January 1, 1908.

The Elkton Consolidated Mining and Milling Company enjoyed a prosperous year. A reduced force was operated most of the time, consisting of but 1 shift, working 6 days a week. During 1907 the water receded so that at present the ninth level is dry. The Elkton will be greatly benefited by the new drainage tunnel, so the policy of the company is to keep up a moderate output from the present dry levels until thus relieved of the water at depth.

The El Paso Consolidated Company's annual report shows a greatly reduced output, amounting to only 5,402 short tons, containing $188,936 in gross values, or less than one-fourth of the 1906 production. This company will be among the very first to be served by the new drainage tunnel, and accordingly operations have been restricted to the upper levels.

The output from the Strattons' Independence mine also shows a very large decrease as compared with that of 1906, but the average value per ton of ore shipped remained rather high, being nearly $36.50 to the ton. The lower grade ores were probably being saved for the company's new mill.

The Granite Gold Mining Company, one of the big consolidations of recent years, remains a large producer. Much development work was done.

Production was reported by the Dante, Findley-Shurtloff, Gold Sovereign, Isabella, Jerry Johnson, Raaler, Ajax, Anchoria-Leland, Cresson, Doctor Jack-Pot, Forest Queen, Gold Dollar, Jo Dandy, Mary McKinney, Work, Stratton Estate, and Strong companies, and by the Ophir mine.

The following table gives the production of the Cripple Creek district from 1891 to 1907:

Production of the Cripple Creek district, Colorado, 1891–1907.[a]

Year.	Gold.	Silver.	Year.	Gold.	Silver.
		Fine ounces.			*Fine ounces.*
1891	$149		1901	$17,261,579	90,884
1892	583,010		1902	16,912,783	62,690
1893	2,010,367	5,019	1903	12,967,338	42,210
1894	2,908,702	25,900	1904	14,504,350	66,638
1895	6,879,137	70,448	1905	15,411,724	49,449
1896	7,512,911	60,864	1906	14,253,245	49,527
1897	10,139,709	57,297	1907	10,913,687	60,397
1898	13,507,244	68,195			
1899	15,658,254	82,520	Total	179,498,028	872,204
1900	18,073,539	80,166			

[a] Figures for 1891–1903 from reports of the Director of the Mint; figures for 1904, 1905, 1906, and 1907 from reports of the United States Geological Survey.

IDAHO.

By V. C. Heikes.

PRODUCTION.

For the calendar year 1907, as reported by 359 producers, including 214 placers, the value of Idaho's production of gold, silver, copper, lead, and zinc amounted to $21,793,064. Of this production the gold yield was 60,754.70 ounces, valued at $1,255,911, and the silver, 8,415,431 ounces, which at the average commercial price for the year was valued at $5,554,185—a total value for the two metals of $6,810,096. This is $381,610 less than the value of the production of gold and silver in 1906. The total ore mined amounted to 1,690,860 tons, of an average value of $12.68 per ton, as against 1,787,673 tons and $13.05 per ton in 1906, a decrease in 1907 of 96,813 tons in quantity and of 37 cents in average value per ton. The tenor of gold and silver in 1907 remains the same as it was in 1906, with an average value per ton of $3.82. In 1907, 57 gold and silver mills, 2 of which used the cyanide process, 43 (including 7 arrastres) used amalgamation only, and 14 used amalgamation and concentration, treated 75,908 tons of ore, containing 28,065.76 ounces of gold and 326,656 ounces of silver, averaging per ton 0.369 ounces of gold, or $7.62, and 4.30 ounces of silver, valued at $2.84. Concentration of ores was carried on in mills situated in 9 counties, distributed as follows: Ada, 1; Blaine, 4; Boise, 4; Custer, 1; Elmore, 1; Idaho, 2; Lemhi, 2; Owyhee, 2; and 14 in Shoshone County. At these concentration mills there were treated 1,448,513 tons of ore, which produced 230,255 tons of concentrates (6.3 into 1). The concentrates contained 8,954.35 ounces of gold, averaging per ton, in gold, 0.0388 ounces, valued at 80 cents, and silver, 26.3 ounces, valued at $17.36. With the copper, lead, and zinc content the concentrates had a gross value of $15,222,440, averaging $66.11 per ton. Crude ore shipped to the smelters amounted to 165.162 tons, containing 6,469.33 ounces of gold, averaging 0.0391 ounces, or 81 cents per ton; 2,028.033 ounces of silver, averaging 12.28 ounces, or $8.10 per ton; 60.36 pounds of copper, and 222.48 pounds of lead per ton. The crude ore shipped had a gross value of $5,415.634, averaging $32.79 in value per ton. The statement of production for 1906 and 1907, showing increase and decrease and values at each year's average commercial prices, is as follows:

Production of gold, silver, and associated metals in Idaho in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold........fine ounces..	55, 587. 73	$1, 149, 100	$60, 754. 70	$1, 255, 911	+ 5, 166. 98	+ $106, 811
Silver ....do....	9, 018, 815	6, 042, 606	8, 415, 431	5, 554, 185	— 603, 384	— 488, 421
Copper ....pounds..	9, 558, 913	1, 844, 870	10, 890, 731	2, 178, 146	+ 1, 331, 818	+ 333, 276
Lead ....do....	255, 014, 446	14, 535, 823	233, 823, 854	12, 392, 664	−21, 190, 592	−2, 143, 159
Zinc ....do....	2, 065, 597	126, 001	6, 985, 732	412, 158	+ 4, 920, 135	+ 286, 157
Total..............	....	23, 698, 400	....	21, 793, 064	....	−1, 905, 336

There was a decrease in the kinds of ore mined, with the exception of copper ore, zinc ore, and lead-zinc ore. Siliceous ore decreased from 97,615 tons in 1906 to 93,238 tons in 1907, a decrease of 4,377 tons. The largest decreases are in Boise, Elmore, Idaho, and Lemhi counties. Owyhee County, by almost doubling its output of 1906 amounting to 27,034 tons, compensated for a large portion of the decrease by producing 47,005 tons. Copper ore increased from 128,517 tons in 1906 to 136,327 tons in 1907, an increase of 7,810 tons, most of which is the gain in Shoshone County. Lead ore decreased from 1,542,650 tons in 1906 to 1,382,399 tons in 1907, a decrease of 160,251 tons. The largest decreases of lead ore were in Blaine, Lemhi, and Shoshone counties. The average value of gold and silver per ton of siliceous ore in 1907 was $13.60; of copper ore, $3.49; of lead ore, $3.30; and of lead-zinc ore, $1.82.

GOLD.

The total gold production for Idaho amounted to 60,754.70 ounces, valued at $1,255,911, in 1907, as against 55,587.73 ounces, valued at $1,149,100, in 1906, an increase of 5,166.98 ounces in quantity and of $106,811 in value. The greater part of the year's output came from Owyhee, Boise, Custer, Idaho, Lemhi, Shoshone, Nez Perce, and Blaine counties, following in order of their yield. Forty-six per cent of the gold production in 1907 was produced at gold and silver mills, which treated 75,908 tons of ore, from which was extracted bullion containing 28,065.76 fine ounces of gold, valued at $580,170, or an average content per ton of 0.3697 ounces, valued at $7.64. From 1,448,513 tons of ore treated at concentrating mills, 230,255 tons of concentrates were saved, containing 8,954.35 ounces of gold, valued at $185,103, or an average value per ton of 80 cents. There were shipped 165,162 tons of crude ore, containing 6,469.33 ounces of gold, valued at $133,733, or an average value of 81 cents per ton.

The additional yield of gold is due partly to the increase in the placer output, which increased in Ada, Bingham, Boise, Lemhi, Nez Perce, and Shoshone counties. The total value of the gold produced by placers in 1906 was $353,481, as against $356,905 in 1907, an increase of $3,424. The reports received from hydraulic and sluicing operations in 1907 give an aggregate output of $277,085, which is $34,108 less than in 1906. It is likely that some producers neglect to distinguish drift mining from other methods, but those reporting from these mines give an output of $5,374 in 1907, which is an increase of $1,434 over the amount reported in 1906. Six dredges operated on placers in Idaho during 1907, as against 3 in 1906. The gold produced amounted to $74,434, and is 66.4 per cent greater than that in 1906. The operations by dredges projected on Snake River, frequently mentioned in the press, did not materialize, and the only important mining by this method was reported from Boise Basin of Boise County, Lemhi County, and Nez Perce County, at Pierce, where one installation has been in successful operation for the last two years and 2 others are contemplated.

Source of gold production in Idaho by kinds of ore in 1907, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Ada and Bear Lake	101.34	277.15					378.49
Bingham	373.11		3.68				376.79
Blaine	2.37	865.81		442.92			1,311.11
Boise	8,040.41	3,341.07					11,381.48
Bonner		1.98					1.98
Canyon	14.80						14.80
Cassia	42.09			18.76			60.86
Custer	415.45	2,803.62	5,285.10	3.50			8,507.67
Elmore	200.75	4,201.08					4,401.84
Fremont			4.74				4.74
Idaho	1,964.02	3,377.54	15.83				5,357.39
Kootenai	338.63						338.63
Latah	118.52						118.52
Lemhi	1,570.93	2,289.91	139.85	73.07			4,073.76
Lincoln	24.28						24.28
Nez Perce	2,622.46	12.77					2,635.23
Oneida	424.93						424.93
Owyhee	66.18	17,150.66	.74				17,217.58
Shoshone	833.55	87.44	383.18	2,575.27		72.60	3,952.04
Twin Falls	109.91						109.91
Washington	1.55		61.14				62.69
Total	17,265.28	34,409.04	5,894.26	3,113.52		72.60	60,754.70

Production of gold in Idaho in 1906 and 1907, by kinds of ore, in fine ounces.

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
1906	17,099.62	33,235.06	2,516.40	2,675.17	4.08	57.40	55,587.73
1907	17,265.28	34,409.03	5,894.26	3,113.52		72.60	60,754.70
Increase (+) or decrease (−)	+165.66	+1,173.97	+3,377.86	+438.35	−4.08	+15.20	+5,166.97

SILVER.

The silver yield amounted to 8,415,431 ounces, valued at $5,554,185, in 1907, as against 9,018,815 ounces, valued at $6,042,606, in 1906, a decrease of 603,384 ounces in quantity and of $448,421 in value. The output of silver came mainly from lead ores from which were produced 6,817,839 ounces, 96.7 per cent of which was credited to the Coeur d'Alene region of Shoshone County; the next important output, derived mainly from siliceous ores, was credited to Owyhee County, which produced 793,942 ounces in 1907, as against 737,578 ounces in 1906, an increase of 56,364 ounces. The largest increase of silver was contained in siliceous ore, which, in 1907, produced 843,077 ounces, as against 765,549 ounces in 1906, an increase of 77,528 ounces. There was also an increase in lead-zinc ore, which, in 1906, contained 65,174 ounces of silver, as against 214,990 ounces in 1907, an increase of 149,816 ounces. Silver decreased in placers, copper ore, and lead ore. From 1,448,513 tons of ore sent to concentration mills, which produced 230,255 tons of concentrates, came 6,057,224 ounces of silver, averaging 26.306 ounces per ton. From 165,162 tons of crude ore shipped to the smelters, 2,028,033 ounces were produced, an average of 12.28 ounces of silver per ton, and from bullion from gold and silver mills, 326,656 ounces were produced from 75,908 tons of ore, an average of 4.30 ounces per ton. Shoshone County is credited with 7,266,862 ounces, valued at $4,796,129, in 1907, as against 7,944,338 ounces, valued at $5,322,706, in 1906, a decrease of 677,476 ounces in quantity and of $526,577 in value. This is the largest decrease in Idaho. In 1907 the lead ore contained 6,817,839 ounces; the copper ore, 536,007 ounces; the lead-zinc ore, 214,990 ounces; the siliceous ore, 843,077 ounces; and placers, 3,518 ounces. Owyhee County continues to rank second in the production of silver, with Blaine, Custer, and Lemhi counties following.

Source of silver production in Idaho by kinds of ore in 1907, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Ada and Bear Lake	33	133	39				205
Bingham	15		31				46
Blaine	9	3, 945	17	166, 396			170, 367
Boise	1, 768	15, 785					17, 553
Bonner		9, 357		1, 480			10, 837
Canyon	4						4
Cassia	3			287			290
Custer	244	3, 109	78, 792	6, 171			88, 316
Elmore	121	10, 134					10, 255
Fremont		855	669				1, 524
Idaho	394	1, 728	58				2, 180
Kootenai	17						17
Latah	17						17
Lemhi	128	4, 878	446	45, 120			50, 572
Lincoln	1						1
Nez Perce	565						565
Oneida	23						23
Owyhee	32	793, 018		892			793, 942
Shoshone	137	135	454, 107	6, 597, 493		214, 990	7, 266, 862
Twin Falls	7						7
Washington			1, 848				1, 848
Total	3, 518	843, 077	536, 007	6, 817, 839		214, 990	8, 415, 431

Production of silver in Idaho in 1906 and 1907, by kinds of ore, in fine ounces.

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
1906	3, 665	765, 549	564, 123	7, 616, 612	3, 692	65, 174	9, 018, 815
1907	3, 518	843, 077	536, 007	6, 817, 839		214, 990	8, 415, 431
Increase (+) or decrease (−)	−147	+77, 528	−28, 116	−798, 773	−3, 692	+149, 816	−603, 384

COPPER.

The output of Idaho increased from 9,558,913 pounds, valued at $1,844,870, in 1906, to 10,890,731 pounds, valued at $2,178,146, in 1907, an increase of 1,331,818 pounds in quantity and of $333,276 in value. Shoshone County, in the Coeur d'Alene region, produced mainly from the Snowstorm mine, and yielded the largest part of the output. Custer County holds second place in the State as a producer of copper, and increased its output from 2,815,286 pounds, valued at $543,350, in 1906, to 3,230,946 pounds, valued at $646,189, in 1907, an increase of 415,660 pounds in quantity and of $102,839 in value. The output is due principally to the production of the White Knob and Lost Packer mines. Other important productions were made by Washington, Fremont, and Lemhi counties.

LEAD.

The lead produced in Idaho shows a decrease from 255,014,446 pounds, valued at $14,535,823, in 1906, to 233,832,854 pounds, valued at $12,392,664 in 1907, a decrease of 21,190,592 pounds in quantity and of $2,143,159 in value. Decreases are noted in Shoshone and Washington counties, while all other counties show increases. The lead output is credited largely to the Coeur d'Alene region, which produced 229,442,987 pounds, valued at $12,160,478 in 1907. The decrease noted for the State belongs principally to Shoshone County.

ZINC.

As in 1906, the output is largely from Shoshone County. It amounted, for the State, to 6,985,732 pounds, valued at $412,158, in 1907, and shows an increase of 4,920,135 pounds over that produced in 1906. Blaine County produced 37,077 pounds, valued at $2,187, in 1907, which is an increase of 26,478 pounds in quantity and of $1,541 in value over the production of 1906.

ANTIMONY.

The production of antimony continues from one property in the Coeur d'Alene district, in Shoshone County. No new deposits have been reported.

MINING INDUSTRY IN IDAHO IN 1907.

The mining conditions were prosperous during the first eight months of the year, due to the full operation of all profitable mines and to the shipment of low-grade ore, which was made possible by the high prices of metals. There was a scarcity of labor with the big producers, brought about mainly by the smaller operators paying higher prices. This labor scarcity eventually became general, and with the high price of timbers and other material the cost of mining was almost prohibitive. The shippers of ore suffered during the first part of 1907 from a shortage of cars, and this, with the scarcity of money for miners' pay during the last three months of the year, closed several of the important metal producers of the State. In railroad building, the event of greatest importance, benefiting principally the Coeur d'Alene region in Shoshone County, was the initial construction work of a railway to tap the mineral region on the North Fork of the Coeur d'Alene River. This railroad, known as the

Idaho Northern, starts near Kingston, a station on the Oregon Railroad and Navigation Company's line, and follows the north fork of the Coeur d'Alene River to Prichard Creek, and up this creek to Raven, a point a short distance above Murray. The railroad will be 33 miles in length when completed. Another line ,connecting Salmon City, in Lemhi County, with Armstead, near Dillon, Mont., on the Oregon Short Line Railway, is being surveyed. This will cross the main range through Lemhi and Junction passes. A branch survey from this line is reported to have been made into Lemhi Valley up to the Gilmore district, at its head, which also traverses the Junction district in Lemhi County. The road is needed, as no doubt many mines outside of the two districts mentioned could provide a considerable tonnage of shipping ore. A branch line of the Oregon Short Line Railway is under construction down the Snake River, on the Oregon side, from Huntington to Lewiston, and will be beneficial to the mining districts near the river, in Washington, Idaho, and Nez Perce counties. From Spokane, Wash., through Kootenai and Bonner counties, the Spokane International Railway was nearly completed, and will furnish transportation to a number of small mining districts. Of importance in milling practice was the successful operation of the first tube mill for fine grinding and cyanide treatment in the Black Pearl mill, in West View district, of Boise County. Several new devices for dry concentration will be tried for the first time in Idaho in the new 250-ton concentration mill that is being constructed for the Idaho Consolidated mines, near Bellevue, in Blaine County. The equipment will consist of Sutton, Steele & Steele dry concentrating tables and classifiers, vibromotor ore sizer, and dielectric separator; also, Wilfley and James wet concentration tables. At Sanpoint, in Bonner County, the Panhandle smelter, the only custom lead-smelting plant in the State, operated during a short season and produced some lead bullion. Three lines of railway reach this smelter. At the close of 1907 preparations were being made to operate again.

Production of gold, silver, copper, lead, and zinc in Idaho, in 1906 and 1907, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Ada and Bear Lake	378.49	$7,824	205	$136	1,221	$244
Bingham	376.79	7,789	46	30	1,974	395
Blaine	1,311.11	27,103	170,367	112,442	35,919	7,184
Boise	11,381.48	235,276	17,553	11,585	....	....
Bonner	1.98	41	10,837	7,152	....	....
Canyon	14.80	306	4	3	....	....
Cassia	60.86	1,258	290	191	....	....
Custer	8,507.66	175,869	88,316	58,289	3,230,946	646,189
Elmore	4,401.84	90,994	10,255	6,768	....	....
Fremont	4.74	98	1,524	1,006	219,000	43,800
Idaho	5,357.39	110,747	2,180	1,439	3,043	609
Kootenai and Latah	457.12	9,450	34	22	....	....
Lemhi	4,073.76	84,212	50,572	33,377	52,461	10,492
Lincoln	24.28	502	1	1	....	....
Nez Perce	2,635.23	54,475	565	373	....	....
Oneida	424.93	8,784	23	15	....	....
Owyhee	17,217.58	355,919	793,942	524,002	119	24
Shoshone	3,952.04	81,696	7,266,862	4,796,129	7,199,648	1,439,929
Twin Falls	109.91	2,272	7	5	....	....
Washington	62.69	1,296	1,848	1,220	146,400	29,280
Total	60,754.70	1,255,911	8,415,431	5,554,185	10,890,731	2,178,146

Production of gold, silver, copper, lead, and zinc in Idaho—Continued.

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Ada and Bear Lake					$8,204
Bingham					8,214
Blaine	2,250,164	$119,259	37,077	$2,187	268,175
Boise	47,903	2,539			249,400
Bonner	3,580	190			7,383
Canyon					309
Cassia	14,000	742			2,191
Custer	104,605	5,544			885,891
Elmore					97,762
Fremont	14,614	774			45,678
Idaho					112,795
Kootenai and Latah					9,472
Lemhi	1,932,356	102,415			230,496
Lincoln					503
Nez Perce					54,848
Oneida					8,799
Owyhee	13,645	723			880,668
Shoshone	229,442,987	12,160,478	6,948,655	409,971	18,888,203
Twin Falls					2,277
Washington					31,796
Total	233,823,854	12,392,664	6,985,732	412,158	21,793,064

Tonnage of ore sold or treated, number of mines producing, and tenor of ores in Idaho, in 1906 and 1907, by counties.

County.	Total tonnage of ore sold or treated.		Deep mines producing.		Total average value per ton.		Average value per ton in gold and silver.		Total value of deep mines.
	1907.	Increase (+) or decrease (—).	1906.	1907.	1906.	1907.	1906.	1907.	
	Short tons.	*Short tons.*							
Ada and Bear Lake	226	— 6,039	2	5	$4.08	$26.93	$4.08	$25.85	$6,087
Bingham	7	— 23	1	1	4.60	70.14	4.60	13.71	491
Blaine	14,829	— 3,015	15	22	13.14	18.08	7.56	9.41	268,120
Boise	8,369	— 8,037	13	18	5.70	9.80	5.70	9.50	82,023
Bonner	99	+ 99		5		74.58		72.66	7,383
Canyon									
Cassia	14	+ 7	1	1	69.57	94.21	5.57	41.21	1,319
Custer	44,422	+ 2,260	7	11	16.63	19.75	3.65	5.07	877,142
Elmore	6,733	— 8,362	6	10	7.37	13.89	7.37	13.89	93,532
Fremont	970	+ 870	1	2	66.96	47.09	1.34	1.14	45,678
Idaho	13,427	— 4,703	12	17	5.90	5.36	5.90	5.31	71,935
Kootenai		— 20	1		77.30		77.30		
Latah									
Lemhi	12,527	— 4,939	11	18	10.04	15.80	5.86	6.79	197,938
Lincoln									
Nez Perce	3	— 1,374	4	1	7.85	88.00	7.85	88.00	264
Oneida									
Owyhee	47,020	+19,986	5	9	25.45	18.70	25.45	18.68	879,279
Shoshone	1,541,670	—81,305	28	23	13.01	12.24	3.33	3.15	18,870,882
Twin Falls									
Washington	544	— 2,218	4	2	23.66	58.39	3.60	5.57	31,764
Total	1,690,860	—96,813	111	145	13.05	12.68	3.82	3.82	21,433,837

Tonnage of milling and smelting ore and concentrates, with metallic contents, produced in Idaho in 1907, by counties.

County.	Ore to gold and silver mills.			Quantity of ore to concentrating mills.
	Quantity.	Gold in bullion.	Silver in bullion.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
Ada and Bear Lake	216	122.35	46	
Bingham				
Blaine	3,295	273.77	205	3,390
Boise	8,099	1,805.40	955	270
Bonner				
Cassia				
Custer	5,832	2,711.20	2,821	
Elmore	6,719	4,043.94	7,326	
Fremont				
Idaho	13,419	3,242.49	1,656	
Lemhi	7,552	2,267.95	4,050	3,585
Nez Perce	2	11.22		
Owyhee	30,753	13,563.52	309,590	16.250
Shoshone	21	23.92	7	1,425,018
Washington				
Total	75,908	28,065.76	326,656	1,448,513
Per ton		0.3697	4.303	

County.	Concentrates produced.						Total value of concentrates.
	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	
	Short tons.	*Fine ozs.*	*Fine ozs.*	*Pounds.*	*Pounds.*	*Pounds.*	
Ada and Bear Lake	40	154.80	87				$3,257
Bingham							
Blaine	848	590.07	32,087	9,421	257,699		48,917
Boise	1,401	1,535.66	14,830		47,903		44,072
Bonner							
Cassia							
Custer	2	92.43	288				2,101
Elmore	44	120.54	2,468				4,121
Fremont							
Idaho	45	146.31	75				3,074
Lemhi	1,223	78.24	27,309	31,847	1,260,516		92,817
Nez Perce							
Owyhee	194	3,583.94	483,214				393,008
Shoshone	226,458	2,652.36	5,496,866	880,835	195,512,709	6,948,655	14,631,073
Washington							
Total	230,255	8,954.35	6,057,224	922,103	197,078,827	6,948,655	15,222,440
Per ton		0.0388	26.306				

Crude ore shipped to smelters from Idaho in 1907, by counties.

County.	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Ada and Bear Lake	10		39	1,221			$270
Bingham	7	3.69	31	1,974			492
Blaine	7,994	444.89	138,066	26,498	1,992,465	37,077	213,409
Boise							
Bonner	99	2.00	10,837		3,580		7,383
Cassia	14	18.76	287		14,000		1,319
Custer	38,590	5,288.60	84,963	3,230,946	104,605		817,134
Elmore	14	36.57	340				980
Fremont	970	4.75	1,524	219,000	14,614		45,678
Idaho	8	4.57	55	3,043			748
Lemhi	816	156.65	19,085	20,614	671,840		55,565
Nez Perce	1	1.55					32
Owyhee	17	3.94	1,106	119	13,645		1,558
Shoshone	116,078	442.22	1,769,852	6,318,813	33,930,278		4,239,310
Washington	544	61.14	1,848	146,400			31,764
Total	165,162	6,469.33	2,028,033	9,968,628	36,745,027	37,077	5,415,634
Per ton		0.0391	12.28	60.36	222.48	0.224	32.79

Subdivision of tonnage of ore sold or treated in Idaho in 1907, by counties, in short tons.

County.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.
Ada and Bear Lake	216	10				
Bingham		7				
Blaine	3,694	67	10,986	82		
Boise	8,369					
Bonner	65		34			
Canyon						
Cassia			14			
Custer	5,832	38,428	162			
Elmore	6,733					
Fremont		950	20			
Idaho	13,373	54				
Kootenai						
Latah						
Lemhi	7,866	322	4,339			
Nez Perce	3					
Oneida						
Owyhee	47,005		15			
Shoshone	82	95,945	1,366,829			78,814
Twin Falls						
Washington		544				
Total	93,238	136,327	1,382,399	82		78,814
Value per ton in gold and silver	$13.60	$3.49	$3.30	None.		$1.82

Production of placer gold in Idaho in 1907, by counties.

Ada	$2,095	Lemhi	$32,474
Bingham	7,713	Lincoln	502
Blaine	49	Nez Perce	54,211
Boise	166,210	Oneida	8,784
Canyon	306	Owyhee	1,368
Cassia	870	Shoshone	17,231
Custer	8,588	Twin Falls	2,272
Elmore	4,150	Washington	32
Idaho	40,600		
Kootenai and Latah	9,450	Total	356,905

Gold production of Idaho placers by different methods, 1906 and 1907.

	Hydraulic.[a]	Drift.	Dredge.	Total.
1906 ... fine ounces	15,054.30	190.59	1,854.73	17,099.62
1907 ... do	13,404.27	260.05	3,600.96	17,265.28

[a] Includes sluicings.

Number of producing mines classified by chief products in Idaho in 1907, by counties.

County.	Gold placer mines.				Deep mines.									Total mines producing.
	Hydraulic.	Dredge.	Drift.	Total.	Gold.	Silver.	Gold and silver.	Gold, silver, and copper.	Gold, silver, copper, and lead.	Gold, silver, and lead.	Silver and lead.	Gold, silver, lead, and zinc.	Total.	
Ada and Bear Lake	4	....	....	4	1	....	3	1	......	......	......	......	5	9
Bingham	9	1	....	10	....	....	....	1	......	......	......	......	1	11
Blaine	2	....	....	2	....	....	....	2	6	7	6	1	22	24
Boise	49	1	....	50	1	....	16	......	......	1	......	......	18	68
Bonner	......	....	....	......	....	2	1	......	......	......	2	......	5	5
Canyon	3	....	....	3	....	....	....	......	......	......	......	......	......	3
Cassia	1	....	....	1	....	....	....	......	......	1	......	......	1	2
Custer	6	1	....	7	....	....	4	2	3	2	......	......	11	18
Elmore	12	....	....	12	....	....	10	......	......	......	......	......	10	22
Fremont	......	....	....	......	....	....	....	1	......	......	1	......	2	2
Idaho	36	....	6	42	1	....	12	4	......	......	......	......	17	59
Kootenai	1	....	....	1	....	....	....	......	......	......	......	......	......	1
Latah	8	....	....	8	....	....	....	......	......	......	......	......	......	8
Lemhi	15	1	2	18	....	....	13	2	1	1	1	......	18	36
Lincoln	2	....	....	2	....	....	....	......	......	......	......	......	......	2
Nez Perce	28	1	....	29	1	....	....	......	......	......	......	......	1	30
Oneida	3	....	....	3	....	....	....	......	......	......	......	......	......	3
Owyhee	8	....	....	8	....	....	8	......	1	......	......	......	9	17
Shoshone	8	1	1	10	....	....	[a] 3	2	6	7	3	2	23	33
Twin Falls	3	....	....	3	....	....	....	......	......	......	......	......	......	3
Washington	1	....	....	1	....	....	....	2	......	......	......	......	2	3
Total	199	6	9	214	4	2	70	17	17	19	13	3	145	359

[a] One antimony.

REVIEW BY INDIVIDUAL COUNTIES.

ADA COUNTY.

The output of the county amounted in value to $7,934 from the operation of placers along Boise River and from quartz mining. The decrease in value of total output from 1906 was $18,909.

Black Hornet district.—The Last Hope Mining Company continued work in driving a crosscut surface drift. It is 250 feet long, and driven for the purpose of cutting the lode 150 feet below the surface. The ore milled in the 3-stamp amalgamation plant came from a stope near the surface.

Highland district.—On the Casebeer placer the Anna Placer Company took out some gold in the development of the property. The average gold fineness in this district is about 0.807, and is worth $16.68 per ounce.

McIntyre district.—The Picket Pin Gold Mining Company (Limited), has developed its quartz property to a depth of 80 feet with a vertical shaft, and also has a prospect drift 300 feet. The country rock is granite with gold-bearing quartz fissures, averaging a low content in gold. A test was made of the ore in an amalgamation mill having a capacity of 5 tons of ore per day.

Neal district.—The Gold Eagle Mining and Milling Company operated its property a short time during the first part of the year, and produced some bullion and concentrate. The 400-foot incline shaft has levels at each 100 feet. The ore occurs in a fissured zone in granite.

Shaw Mountain district.—The Big Giant Gold Mining Company continues to develop its property and accomplished 2,642 feet of work in 1907, which makes a total of about 7,000 feet in crosscuts, drifts, and raises. The gold ore thus far exposed, though low grade, is easily treated by amalgamation and cyanide processes.

Snake River district.—The Utility Gold and Power Company erected in 1906 a dredge on the Ada County side of Snake River. The mechanical device constituting the recovery system rests on an ordinary dredge boat, and delivery of gravel and sand to it is made by means of an endless chain of dredging buckets. The features of the system consist of (1) an initial separation and washing of the coarse and fine gravels by means of a rotating screen, partially immersed in water, (2) the recovery of the coarse gold in ordinary riffle boxes, (3) the recovery of the fine gold and the fine gravels and sands, forced by water jets against the amalgamating plates on the sides and ends of the tank, instead of gravity amalgamation, and (4) the magnetic removal of the iron in the sands constituting the concentrate. The plant, during experimental work, is reported as handling 1 cubic yard per minute, operated by 2 men on shift. The pump is electrically driven by a 125 horsepower motor, and the rotating screen by a motor of 65 horsepower, which also operates the tailing conveyor. The company was reported out of business during 1907, so that final results and the cause for closing down of the plant are not known.

BANNOCK COUNTY.

Fort Hall district.[a]—Developments were continued during 1907 on the property of the Fort Hall Mining Company. The ore-bearing zone, which was cut by the adit at 3,555 feet, is approximately 125 feet thick, comprising crumpled and contorted layers of shale and thin-bedded limestones. This zone, containing iron and copper pyrite and finely disseminated galena, was tested for its entire width and the company states that it averaged $2.92 per ton, with copper at 15 cents per pound. The ratio of concentration of 11.05 tons of crude ore to 1 ton of concentrate gave the following results: Copper, 12.3 per cent; gold, 0.13 ounces per ton; silver, 4.30 ounces per ton; iron, 26.4 per cent; silica, 16.1 per cent; and lead, 0.8 per cent. At the Moonlight property, about 6 miles north of the Fort Hall mine, development work was accomplished by a few men. A carload of sulphide copper ore was taken out and is being held for a better market.

BEAR LAKE COUNTY.

Along Bear River valley several interesting disclosures of copper and lead ore were made, and a number of shipments made to the smelters in Utah. The Bonanza group, developed by the Bonneville Copper Company, installed a new gasoline hoist and continued sinking its shaft, now 150 feet deep. From surface work a test shipment of copper ore containing silver was made. The Blackstone

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[a] Weeks, F. B., and Heikes, V. C. Notes on Fort Hall mining district, Idaho: Contributions to Economic Geology, Bull. U. S. Geol. Survey No. 340, 1908, pp. 21–29.

Mining and Milling Company produced from its property during development a high-grade carbonate lead ore with considerable galena interspersed through it. At Cokeville, 30 miles east of Montpelier, the Collett copper property is under development. Regular shipments of phosphates[a] continue to be made to the Pacific coast from near Montpelier. With lower freight rates this industry should thrive.

BINGHAM COUNTY.

Mount Pisgah district.—Of the placer work performed in the district, the most important was that of the American Hydraulic Placer Mining Company, and of the Barnes claims. These operations were carried on by hydraulicking. The placer gold in this district averages in fineness about 0.960, and is valued at $19.84 per ounce. From the Caribou and Monte Cristo claims small test shipments of ore are reported. Both properties are holding shipments of high-grade copper ore for better metal prices.

Snake River district.—The placer gold from this district amounted to 185.22 ounces taken from the Woodworth Bar placer, Buena Vista, Martin, Gold Point, and other properties along the Snake River. The average fineness of the placer gold in this vicinity is 0.951, valued at $19.66 per ounce.

BLAINE COUNTY.

Production of gold, silver, and associated metals in Blaine County, Idaho, in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold....................fine ounces..	547.50	$11,318	1,308.74	$27,054	+ 761.24	+$15,736
Silver ....do....	184,337	123,506	170,358	112,436	− 13,979	− 11,070
Copper ....pounds..	....	....	35,919	7,184	+ 35,919	+ 7,184
Lead ....do....	1,737,605	99,043	2,250,164	119,259	+512,559	+ 20,216
Zinc....................do....	10,599	646	37,077	2,187	+ 26,478	+ 1,541
PLACERS.						
Gold....................fine ounces..	110.34	2,281	2.37	49	− 107.97	− 2,232
Silver ....do....	....	....	9	6	+ 9	+ 6
Total..............................	....	236,794	....	268,175	....	+ 31,381

Source of gold and silver in Blaine County, Idaho, in 1906 and 1907, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Lead ore.	Copper ore.	Lead-zinc ore.	Total.
Gold........................	1906	110.34	345.00	201.15	....	1.35	657.84
	1907	2.37	865.82	442.92	....	....	1,311.11
Silver........................	1906	....	265.00	165,932.00	....	18,140.00	184,337.00
	1907	9.00	3,945.00	166,396.00	17.00	....	170,367.00

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[a] Weeks, F. B., and Ferrier, W. F., Phosphate deposits in western United States: Contributions to Economic Geology, Bull. U. S. Geol. Survey No. 315, 1907, pp. 460–461, and Bull. No. 340, pp. 3–9.

From 14,829 tons of ore produced by 22 deep mines, there were obtained $27,054 in gold and 170,358 ounces of silver, valued at $112,436, a total value of $139,490 of gold and silver, at an average of $9.41 per ton. From 2 placer properties there were obtained $49 in gold and 9 ounces of silver, valued at $6. Compared with the output of 1906 the gold production from deep mines showed an increase of 761.24 ounces; silver a decrease of 13,979 ounces; and the tonnage a decrease of 3,015 tons. The average value per ton of the ore increased from $13.14 in 1906 to $18.08 in 1907. The placer yield showed a large decrease in production from $2,281 in gold in 1906 to $49 in 1907. The closing of placer operations on Snake River in this county was responsible for this decrease. From 3,390 tons of ore treated at concentration mills 848 tons of concentrates were saved, containing 590.07 ounces of gold, valued at $12,198, and 32,087 ounces of silver, valued at $21,177, averaging per ton $1.44 in gold and 37.8 ounces of silver, valued at $24.97. In addition to these values, copper and lead gave the concentrates a total average value of $57.68 per ton. There were shipped to smelters 7,994 tons of crude ore, containing 444.90 ounces of gold, valued at $9,197; and 138,066 ounces of silver, valued at $91,124, an average value per ton of $1.15 in gold, and 17.27 ounces in silver, valued at $11.40. When, to these values the values of copper and lead are added, the smelting ore shipped has a total average value of $26.69 per ton. The ores shipped are sold to the smelters in Utah. The largest yield of gold is from siliceous ores and of silver from lead ores.

Dome district.—This district is located on Little Lost River. Howe, in Bingham County, is the principal supply point. The Belnap, Red Bird, and Wilbert mining companies were producers of lead ore, carrying values in silver. Small shipments were also made from the Ingersoll and Daisy Black claims. Most of the ore was taken out by lessees.

Hamilton district.—A test lot of ore, averaging 17 per cent copper, was shipped by the Copper and Uranium Mining Company to the Garfield smelter, in Utah. The property is known as the Automatic group, and the vein worked is said to be a contact between quartzite and limestone.

Lava Creek district.—The Ella claim, operated by the Idaho Lead, Silver, and Zinc Company, produced copper ore containing lead and silver.

Mineral Hill district.—The most important operations in the district were carried on by the Quincy Junior Mining Company, the Wood River Zinc Company, the Idaho Consolidated Mines Company, the Della Mountain Mining Company, the Croesus Gold and Copper Mining Company, and the Eureka Development Company (Limited). The ores are principally lead, containing silver, with the exception of the Croesus, which produces both a gold ore and a lead ore. The gold is partly caught on plates in a 10-stamp mill and partly shipped as concentrate, and the lead ore is either shipped crude or concentrated. The Eureka Development Company is equipped with a 60-ton concentration mill, and is developed by an incline shaft sunk at an inclination of 70°. The Croesus mine is developed to a depth of 800 feet by a vertical 3-compartment shaft with levels at each 100 feet. On the sixth level is disclosed a body of massive pyrrhotite ore, 6 to 10 feet wide by 125 feet long. This ore is said to assay 2 ounces of gold, and, besides containing an excess in iron, has some copper. The gold ore is obtained down to the 600-foot level from a distinct gold-bearing vein, and on the 700-foot and 800-foot levels lead, silver, and gold are obtained from a galena ore. A new concentration plant, equipped with Wilfley tables, is about to be completed, giving a capacity for wet concentration of 125 tons and for dry concentration with Sutton-Steele tables of 125 tons. The ore and concentrates shipped came principally from testing work for the new mill. The Nay-Aug group, of the Wood River Zinc Company, shipped crude ore, containing lead, silver, and gold, as well as a number of tons of zinc ore. The longest adit by which the property is developed is 1,200 feet. The Quincy Junior Mining Company shipped crude ore and a concentrate containing lead and silver. This property has a record of producing in the neighborhood of $75,000 worth of ore, and at depths not exceeding 300 feet on any part of the group.

Rosetta district.—The Dollarhide Mining Company was developed by a series of drifts run from the surface on a fissure in granite. Development work was performed in 1907 amounting to 1,200 feet. This company also operated the Carrie Leonard group under lease and bond.

Warm Springs district.—The ores produced from this district contained principally lead, with some silver. The main producers for 1907 were the Mackinaw Copper Mining Company, the New Hope claim, the North Star, the West Side, and the Free Coinage claims. The Boston-Idaho Mining Company operated the Ontario group, consisting of 4 patented and 7 unpatented claims located near Ketchum. This property is equipped with concentration mill of a daily capacity of 30 tons, left by the former owners. It was repaired and put in condition for operation during 1907.

BOISE COUNTY.

Production of gold, silver, and associated metals in Boise County, Idaho, in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold....fine ounces..	4,418.19	$91,332	3,341.07	$69,066	−1,077.12	−$22,266
Silver....do....	3,246	2,175	15,785	10,418	+ 12,539	+ 8,243
Lead....pounds..	....	....	47,903	2,539	+ 47,903	+ 2,539
PLACERS.						
Gold....fine ounces..	6,660.83	137,692	8,040.41	166,210	+1,379.58	+ 28,518
Silver....do....	1,663	1,114	1,768	1,167	+ 105	+ 53
Total....	....	232,313	....	249,400	....	+ 17,087

Source of gold and silver in Boise County, Idaho, in 1906 and 1907, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Total.
Gold....	1906	6,660.83	4,418.20	11,079.03
	1907	8,040.41	3,341.07	11,381.48
Silver....	1906	1,663.00	3,246.00	4,909.00
	1907	1,768.00	15,785.00	17,553.00

The gold and silver output of this county in 1907 amounted to $235,276 in gold, and 17,553 ounces of silver, valued at $11,585, a total of $246,861 in gold and silver. From 8,369 tons of ore produced by 18 deep mines, there were obtained $69,066 in gold, and 15,785 ounces of silver, valued at $10,418, a total of $79,484 in gold and silver, or an average of $9.50 per ton. From 50 placer reports the returns show $166,210 in gold and 1,768 ounces of silver, valued at $1,167. The total value of the placer yield was $167,377. Compared with 1906, the gold production shows a decrease in the amount produced by deep mines and an increase in that produced from placer operations. Of the ore treated the total average value increased from $5.70 in 1906 to $9.80 in 1907. These average values are principally for gold and silver. A little lead was reported in 1907.

Boise Basin district.—At Quartzburg, the Belshazzar property on Granite Creek was operated to a small extent during the year and shipped gold and silver bullion. In making tests on ore, the Golden Rod Mining Company shipped from the Shamrock and Mineral Hill claims, located near Placerville, some gold and silver bullion. The Amigo Mining Company developed its Sunday property to a depth of 120 feet by a shaft, and has 425 feet of drifting, 200 feet of which was accomplished in 1907. The property is equipped with a 5-foot Huntington mill and vats sufficient in capacity to treat 25 tons of ore per day by the cyanide method. The Golden Age Mining Company, owning the Gold Dollar group, has its vertical shaft sunk to a depth of 200 feet and a surface drift 500 feet long. The surface equipment consists of a 15-stamp plate-amalgamation mill with concentrator, installed during 1907. The property is located at Pioneerville. The principal placer producers in this district continue to be the Woodburn Company, operating the Basin Branch placer near Idaho City; the Garden Gulch Placer Mining Company; the Moline Mining Company, operating the Corcoran placers; the Oaks Mining Company and the Boise Basin Hydraulic and Power Company, operating on the Reed and Boyles Gulch placers, near Placerville. A large amount of the gold taken out is by dredging and hydraulic work, and averages in fineness about 0.750, valued at $15.50 per ounce.

Deadwood basin.—In this district the Merry Blue and the Union claims were operated as usual. On the property is a shaft 150 feet deep and also a surface drift 480 feet long. The ore produced is treated in an arrastra with a capacity of 2 tons per day.

Hayfork district.—The Hayfork group includes the Gold Bug, Switzerland, Humming Bird, and Hercules claims, located near Idaho City. Small quantities of rich gold quartz taken from these properties, pounded to a pulp in a mortar, yielded some gold and silver bullion.

Highland district.—Near Lardo and Highland, on the Boise County side, some placer operations were carried on. The gold here averages in fineness 0.786, and is valued at $16.24 per ounce.

Lake City district.—The Ruby Hill property, near Lardo, produced some placer gold by hydraulic operations. The gold here averages in fineness 0.797, and is valued at $16.47 per ounce.

Moore Creek district.—The Liberty Placer Mining Company, operated by hydraulic methods, produced placer dust having a fineness in gold of 0.827, and valued at $17.09 per crude ounce.

Summit Flat district.—The Black Jack claim, near Centerville, has produced a limited amount of ore, yielding gold and silver bullion after treatment in a 2-stamp Nissen mill.

West View district.—The Black Pearl Mining Company has developed its mine, situated at Pearl, to a depth of 400 feet, with a vertical 3-compartment shaft. The total developments during the year aggregate 7,800 feet. Numerous levels have been driven to cut across the veins of the property. These veins contain talcose and granitic material, and quartz, and carry an average of 20 per cent of iron pyrites, with occasional traces of lead and zinc. The value is in gold and silver, averaging from $8 to $10 per ton. The company has experimented for five years, first with concentration, then with cyanide by the percolation method. These experiments were unsuccessful, and during 1906 the management installed entirely new equipment, consisting of a Sturdevant roll jaw crusher, feeding 8 Nissen stamps, which deliver a 12-mesh pulp on copper amalgamating plates, thence to a Dorr classifier, which delivers it to a 48-inch by 20-inch Tire type of tube mill, electrically driven, in which it is reduced to 100-mesh size. The slimes for the classifier pass from launders to a series of settling tanks. The thickened pulp is taken from the settling tanks and run by gravity into a Hendryx agitator. After agitation of from six to eight hours it is conveyed by means of a centrifugal pump into a Kelley patent filter press at a pressure of from 40 to 50 pounds. A rapid separation immediately occurs, the filtered part coming off quite clear, and the cakes forming to a thickness of 1 inch to 1½ inches within ten minutes' time. These cakes are quickly washed and the cyanide is displaced by wash solution. The gold and silver are removed from the solution by zinc dust. This mill has just been put into operation, and this company is the first in the State to adopt its use. The Osburn mine, operated by the Idaho Gold Mines Development Company, is developed to a depth of 400 feet, crosscutting the ledges at every 100 feet, with drifts aggregating 5,000 feet. The Ellspass mill, concentrators, and cyanide plant have a capacity of 50 tons of ore per day. The plant was completed in November, 1907. The Lincoln Mining Company has developed its property to a depth of 430 feet and the principal workings are on that level. The Bender claim, near Horse Shoe Bend, was productive of a trial shipment of gold ore. Placer mining was carried on at Shafer Creek and Horse Shoe Bend in a small way.

BONNER COUNTY.

Lakeview district.—The Port Arthur, Hidden Treasure, and Grafter claims were productive of lead ore, carrying silver.

Pend d'Oreille district.—The B. F. & H. mine, the Silver Bull Mining Company, and the Black Tail Mountain Mining Company were the only operators producing in the district. They ship mainly silver ore containing less than 5 per cent of lead.

CANYON COUNTY.

Snake River district.—The production of gold from placer operations by rocker and burlap tables along Snake River by small operators amounted to $306. No quartz mining was reported for this county.

CASSIA COUNTY.

The Cumora Mining Company, in Stokes mining district, developed its property and made a shipment of lead-silver ore. It is stated that 200,000 tons of low-grade ore are on the dump, awaiting the erection of a concentration mill. On Snake River, the Sample placer, owned by the Fall Creek Sheep Company, was operated by lessees and produced gold. Some of this ground is reported to be very rich within a foot of the surface, and large areas of it are reported to average in the neighborhood of $1 per yard. It is worked in a small way by sluice and burlap tables. The product from mining operations amounted to $2,191, a decrease of $1,628 from the output of 1906.

CUSTER COUNTY.

The output of the county for 1907, valued at $885,891, was from 11 deep mines and from 7 placers in 2 districts. The deep mines produced 44,422 tons of ore, valued at $877,142, an average of $19.75 per ton. At one of the gold and silver mills a small quantity of pyritic concentrate, containing gold and silver, was produced. The largest part, or 86.8 per cent, of the total yield from deep mines was treated at copper-matting furnaces on two properties, and the lead ores were shipped to smelters in Utah. The lead ore, copper ore, and copper matte shipped was valued at $817,134, an average per ton of $21.17 for the gold, silver, copper, and lead content. The placer yield amounted to $8,588 in gold and $161 in silver. The total metal production amounted to 8,507.66 ounces in gold, valued at $175,869; 88,316 ounces of silver, valued at $58,289; 3,230,946 pounds of copper, valued at $646,189; and 104,605 pounds of lead, valued at $5,544. These figures, compared with those of 1906, show an increase of 2,260 tons of ore in quantity and of $170,798 in value. Gold increased 3,058.19 ounces and $63,219 in value; silver increased 5,580 ounces and $2,856 in value; copper increased 415,660 pounds and $102,839 in value; and lead increased 40,400 pounds and $1,884 in value.

Alder Creek district.—The Empire Copper Company took over the interests of the White Knob Company during 1907. The matte furnaces on the property were operated and produced a high-grade copper matte. The mine is developed by a shaft 700 feet deep and several levels run from the surface, aggregating 5,650 feet. The Black Daisy property was operated by lessees, and a production of lead ore, containing 22 per cent of lead and 6 ounces of silver, was shipped to the smelters. The claim is developed by a 250-foot drift run from the surface.

Bayhorse district.—The Salmon River Mining Company, operating the Pacific property, shipped some ore containing lead, copper, and silver. The property is a distance of 60 miles from the railroad and is operated by lessees.

Loon Creek district.—The principal operations in this district were carried on by the Lost Packer Mining Company, which operated its matte furnace of 100 tons daily capacity during part of the year. Some copper matte was shipped to eastern refiners which averaged

51 per cent of copper, 10 ounces of gold, and 30 ounces in silver. The mine is opened by a series of adits, the lowest one cutting the lode at a depth of 700 feet. The ore contains copper, gold, and silver. Operations ceased at the plant November 1, 1907. It is said that the cost of coke delivered at the Lost Packer mines is $40 per ton, and the treatment charge is $6 per ton.

Stanley Basin district.—The North Star claim, a producer of gold and silver quartz, yielded bullion, extracted by amalgamation in the one stamp mill on the property. The Fort Pitt Mining and Milling Company, operating the Valley Creek and other claims, operated its stamp mill for twenty days, producing gold bullion. From placer operations shipments of bullion were made ranging from 30 to 140 ounces, averaging a gold fineness of 0.704. The main operations were on Joe's Gulch placer and on the property of the Saw Tooth Placer Mining Company (Limited), which owns the Wormack dredge.

Yankee Fork district.—The mine of the Golden Sunbeam Mines Company is situated on Bismark Mountain, 7 miles west of Custer City. The mine is developed by an adit 1,250 feet long. The total development work will aggregate 5,280 feet. The milling plant is equipped with a 6-foot Monadnock mill of a daily capacity of 100 tons and with canvas tables for catching the pyrite containing gold and silver. Gold and silver bullion was sent to the mint and one shipment of concentrate was made to Salt Lake. The deposit is described as a soft, grayish-yellow tuff that contains no base minerals perceptible to the eye excepting an occasional crystal of iron pyrite. The rock of the whole surrounding district is andesite or rhyolite. The Oxarna Gold Mining Company, owning the Julietta claim, is equipped with a 20-stamp mill and concentrators and was a producer of bullion.

ELMORE COUNTY.

The production of the county for 1907 came from 8 districts, in which 10 deep mines produced 6,733 tons of gold and silver ore, aggregating in value $93,532 and averaging $13.89 per ton. No other metals were reported. The ores are treated chiefly at amalgamation mills connected with the mines. Small shipments of ore and pyritic concentrates were forwarded to smelters in 1907. At 8 mills in 4 districts 6,719 tons of siliceous gold ore produced gold and silver bullion containing 4,043.94 ounces of gold, valued at $83,596, and 7,326 ounces of silver, valued at $4,835, a total value of $88,431, and averaging per ton $12.44 in gold and 1.09 ounces of silver. The ores mined in the county are largely of white quartz, yielding about 1 per cent of high-grade concentrate, consisting of iron sulphides rich in gold and antimonial silver minerals. In addition to the bullion yield, there was shipped some concentrate and crude ore, yielding a total of $5,101 in gold and silver. The placer yield in 1907 amounted to 200.75 ounces of gold, valued at $4,150, and 121 ounces of silver, valued at $80; or a total of $4,230. Comparing the figures of production for 1907 with those of 1906, the ore mined and treated decreased 8,362 tons, and the total output of gold decreased 1,992.16 ounces and $41,180 in value; silver, however, increased 4,403 ounces and $2,847 in value; this gives a total decrease for the metal output of $38,333 in value.

Black Warrior district.—Operations were carried on by the following quartz mines: White Ribbon, Double Standard, Fourth of July, and Magnolia.

Bear Creek district.—The production of gold and silver bullion came principally from placer operations on Bear Creek in this district, a large part of the bullion being shipped by Chinese operators. The principal work was carried on by hydraulic methods by the Gray Warrior Mining Company. The average gold fineness of the bullion is 0.798 and the gold is valued at $16.50 per crude ounce.

Highland district.—Near Twin Springs the bench gravel deposits were washed by hydraulic methods during the short season when the water is highest on account of the rapid melting of the snow. The season is no longer than from thirty to thirty-five days. The gold averages in fineness about 0.775 and is valued at $16.02 per crude ounce.

Atlanta or Middle Boise district.—The Pettit mill, under construction by the Bagdad-Chase Gold Mining Company, will be equipped, according to reports, with 20 stamps, vanners, and Callow screens. The concentrate will be roasted and cyanided. The crude ore averages $10 to $12 per ton in gold and silver, and the concentrates, which are to be roasted and treated by cyanide, will average $200 per ton. Electric power will be transmitted from the company's plant on the Middle Fork of the Boise River, a mile from the mill. The mill should be in operation the first part of 1908. The mine is operated through adits to a depth of 500 feet with extensive underground connections. The Monarch mine, of the Atlanta Mines Company, is developed through a 600-foot vertical shaft, with levels at each 100 feet. The milling plant recently installed is of 200 tons daily capacity and will be operated when completed by a hydroelectric plant of its own, located on the Boise River near the mill. The mine is connected with the mill by an aerial tram a mile and a quarter long. The Minerva Mining Company is developing its property by an adit, which is 950 feet long, and a number of crosscut drifts, which approximate 700 feet. A 10-stamp mill, equipped for amalgamation and concentration, was operated part of the year. Concentrate and bullion were shipped. Operation of placers was carried on principally by the Bonanza Mining and Investment Company and on the Sunrise claim. A bed-rock flume was built on the Bonanza property.

Neal district.—The most important producer in this district is the Homestake and Mountaineer Mining Company, which treated gold-bearing quartz ore in a 10-stamp, plate-amalgamation mill. Concentrators and a cyanide plant to treat the tailings were added the latter part of the year. The mine is developed by 2 shafts, respectively, 200 and 400 feet deep. The principal adit is 2,800 feet long. About 1,500 feet of development work were attained during 1907. Gold and silver bullion only were produced. Some placer operations were reported with a production of bullion.

Pine Grove district.—The principal operations were carried on by the C. H. Gold Mines Company, producing gold and silver bullion from the operations of a 10-stamp amalgamation mill and cyanide plant for treating the tailings. There are 4 adits, aggregating in length about 2,600 feet, and crosscuts of 4,300 feet. Some ore, mined several years ago, was shipped from the ore dump of the Jingo and Hornet group.

Snake River district.—On the Midnight placer claims some bullion was produced by rockers. The gold averages in fineness 0.951, and is valued at $19.66 per crude ounce.

Twin Springs district.—Sluicing on the Montana Meadow placer was successfully accomplished by use of the Ruble elevator, and some bullion was produced. Development work on these placers promises a greater production next year.

FREMONT COUNTY.

Skull Canyon district, situated on the west slope of the Bitter Root Range, is 50 miles west of Dubois, on the Oregon Short Line Railroad.

The only producing property in 1907 was operated by the Weimer Copper Company, which has located 130 lode claims, embracing about 2,600 acres extending along a contact of quartzite and limestone, between which is a broad mineralized zone, dipping at an angle of about 17 degrees. This lode matter is cut by innumerable small fissues, each fissure containing high-grade copper ore. The mining has been carried on largely with churn drills, and by blasting and shattering the surface deposit, and sorting the richer ore for shipment by wagon to the railroad. In all there have been shipped 18 cars, of about 45 tons capacity each, of ore containing from 16 to 20 per cent copper, netting the company about $3,000 per car. The panic and low price of copper closed the property in October.

IDAHO COUNTY.

Production of gold, silver, and associated metals in Idaho County, Idaho, in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold..................fine ounces..	4,902.56	$101,345	3,393.36	$70,147	− 1,509.20	− $31,198
Silver........................do	8,332	5,582	1,786	1,179	− 6,546	− 4,403
Copper ....pounds..	....	....	3,043	609	+ 3,043	+ 609
PLACERS.						
Gold..................fine ounces..	3,371.01	69,685	1,964.02	40,600	− 1,406.99	− 29,085
Silver........................do....	597	400	394	260	− 203	− 140
Total..............................	....	177,012	....	112,795	....	− 64,217

In 1907, 15 districts furnished 59 reports, showing a metal production aggregating in value $112,795. This is a decrease from the output of 1906, valued at $177,012, of $64,217. The tonnage of ore treated also decreased from 18,130 tons in 1906 to 13,427 tons in 1907, and in average recovered value per ton from $5.90 to $5.36, a decrease of 4,703 tons in quantity and 54 cents in value per ton. There was less activity in quartz mine operations, as well as in placer mining. For the first time, in 1907, the county records a production of copper contained in one small lot of ore shipped to smelters. A concentrate, averaging $68.31 per ton in gold and silver, was produced by 3 mills treating ore by amalgamation process in remote mining districts. The gold and silver bullion formed the greater part of the metallic contents extracted from 13,419 tons of siliceous ore, treated in 13 mills using principally amalgamation. The ore yielded 3,242.49 ounces of gold, valued at $67,027, 1,656 ounces of silver, valued at $1,093, and averaged per ton, $4.99 in gold and 0.12 ounce in silver, valued at 8 cents.

Big Creek district.—The Moscow claim, near Logan, produced a small amount of gold and silver bullion.

Camp Howard district.—The Rainbow group, situated near Whitebird, shipped some ore containing copper and silver to smelters.

Elk City district.—The American Eagle Consolidated Gold Mining Company owns a gold and silver property, which is developed by an adit 1,400 feet in length. The bullion produced during 1907 came from the treatment of ore from an old dump in a 10-stamp mill equipped for concentration. The Buster Consolidated Mining and Milling Company is a new producer, beginning in 1907. There are a vertical shaft on its property, which has reached a depth of 185 feet, and a drift run from the surface 300 feet long. The ore body is a quartz vein in gneiss and 10 to 20 feet wide. The mill just completed consists of 10 stamps and a cyanide plant of a daily capacity of 40 tons. It is expected that pyritic concentrate containing gold will be shipped to the Tacoma smelter. In 1907 small quantities of gold and silver bullion, probably from experimental operations, were produced by the company. Prospecting of placer ground has been reported as promising success. The South Fork group of claims also produced bullion, the result of the operation of a small stamp mill. Placer operations by the Buffalo Hills Mines Company were carried on by hydraulicking and sluicing. This company has been developing its property for a number of years. It is planned to add further to its equipment at the beginning of 1908 by the installation of a hydraulic elevator. Other companies operating placers were the Gold Hill Placer Mining Company and the Bed Rock Mining Company. From placer operations the output of the district aggregated 239.90 ounces of gold.

Crooks Corral district.—The only producers in this district are placers located along Rapid River. The operations have been carried on by hydraulicking on bench gravel deposits. The Crooks Corral placers are situated on the Snake River slope of the high divide between Salmon and Snake rivers. The streams are only 12 miles apart. The gravel deposit lies on the Snake River rim rock, and in several places has been found to be very rich. The company has spent several thousand dollars in securing water rights and in building ditches, but the elevation is so high and water so limited that the working season is very short.

Dixie district.—The Bentley and a number of other placers have produced bullion obtained by rockers. The fineness of the gold in this district is approximately 0.820, and the gold is valued at $16.95 per crude ounce.

Florence district.—A number of small placer operators reported shipments of bullion, but nothing of great importance was taken out during 1907.

Lolo district.—The properties doing principally development work were the Alta-Idaho Gold and Copper Mining Company, owning the Empire group, and the Tri-Metallic group.

Marshall Lake district.—The Goodenough Mining and Milling Company at Resort operated its 5-stamp amalgamation and concentration mill on quartz ores containing gold and silver.

Newsome district.—The largest output of gold in the district continues to be produced by the Moose Creek Placer Mining Company, which reports working a full season, during which 65,000 cubic yards of gravel were moved by hydraulic and sluicing methods. The equipment consists of 4 giants on 2 pipe lines leading from the pressure box. A powerful head of water is developed by 26 miles of ditches. On the Iron Crown property some development work was performed, and a small amount of bullion was produced from trial runs on ore in an old milling plant. The principal placer operations were on the Old Montana placers, which have recently been taken over by a new company. The Newsome and Leggett Creek Hydraulic Company owns property in the district and has done some development work during 1907, during which a small production was recorded.

Robbins district.—The Cracker Jack Mining and Milling Company produced some gold and silver bullion from the operations of a 10-stamp mill with a small concentrator and cyanide plant, which was erected for treating the concentrate. The vertical shaft on the property is at a depth of 245 feet, and the adit is driven for a distance of 1,500 feet. The Jumbo Mining and Milling Company's property is developed by 4 adits. The lowest one has cut the vein at a depth of 750 feet and is 1,200 feet long. The placer production came principally from the Buffalo Hump Placer Company, operating on the South Fork of Clearwater River by hydraulicking.

Salmon River and Simpson districts.—Quartz mining is reported from the property of the McKinley Gold Mining and Milling Company, which is equipped with a 1-stamp plate-amalgamation mill and Wilfley concentrators. The development consists of a tunnel 485 feet long. The principal output of gold and silver bullion comes from placer operations by hydraulic and drift mining, of which the principal operators are the Horse-Shoe Bend Mining Company, near White Bird, and the Consolidated Hydraulic Mining and Development Company, operating the Slate Creek placers near Freedom. The gold averages in fineness about 0.836, and is valued at $17.28 per crude ounce.

Thunder Mountain district.—The principal operations were carried on by the Thunder Mountain Gold and Silver Mining and Milling Company, owning the Dewey mine. There are two surface levels crosscutting the vein, the longest being 650 feet. The 10-stamp amalgamation mill was operated during the year, producing gold bullion. The Standard Mining and Milling Company, operating the Elk group, recorded a small production of gold and silver. The adit on the property is 1,450 feet long. The average fineness of the gold product in working surface deposits in the vicinity of these mines is 0.843, and the value is $17.42 per crude ounce.

Warren district.—One quartz property was productive of gold bullion, but most of the gold and silver produced came from placer operations. The largest operations were on the property of the

Golden Rule Placer Mining Company. The fineness of the bullion shipped from the district is 0.780 in gold and 0.212 in silver.

KOOTENAI COUNTY.

Camas Cove district.—The Tyson Consolidated Gold Mining and Milling Company has expended a large amount of capital in putting in 8 miles of 10-inch steel pipe and 2½ miles of flumes. The work performed during 1907 was mainly in prospecting and testing the ground. It is expected to operate on a large scale during 1908.

LATAH COUNTY.

Gold Creek district.—Small amounts of placer gold were produced by a number of operators.

Hoodoo and Moscow districts.—Placer gold was produced valued at $1,848.68. The ground was worked by hydraulic mining and sluicing.

LEMHI COUNTY.

Production of gold, silver, and associated metals in Lemhi County, Idaho, in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold.....fine ounces..	3,777.51	$78,088	2,502.83	$51,738	−1,274.68	−$26,350
Silver.....do....	36,324	24,337	50,444	33,293	+ 14,120	+ 8,956
Copper.....pounds..	40,000	7,720	52,461	10,492	+ 12,461	+ 2,772
Lead.....do....	1,144,000	65,208	1,932,356	102,415	+ 788,356	+ 37,207
PLACERS.						
Gold.....fine ounces..	1,346.98	27,844	1,570.93	32,474	+ 223.95	+ 4,630
Silver.....do....	129	87	128	84	− 1	− 3
Total.....	....	203,284	....	230,496	....	+ 27,212

Source of gold and silver in Lemhi County, Idaho, in 1906 and 1907, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Lead ore.	Copper ore.	Total.
Gold.....	1906	1,346.98	3,671.94	4.00	101.58	5,124.50
	1907	1,570.93	2,289.92	73.07	139.85	4,073.77
Silver.....	1906	129.00	1,604.00	33,600.00	1,120.00	36,453.00
	1907	128.00	4,878.00	45,120.00	446.00	50,572.00

Eighteen mines reported an output of 12,527 tons, as against 11 mines and 17,466 tons in 1906. Forty-three per cent of the total tonnage produced in 1907, or 7,552 tons, was treated in gold and silver mills, yielding $46,883 in gold and 4,050 ounces of silver, an average value per ton of $6.21 in gold and 0.54 ounces of silver. At concentration mills 3,585 tons were treated and produced 1,223 tons of concentrates, which yielded $1,617 in gold, 27,309 ounces of silver, 31,847 pounds of copper, and 1,260,516 pounds of lead, averaging per ton, $1.32 in gold; 22.3 ounces of silver; 1.30 per cent of copper and 51.53 per cent of lead. From the shipment of 816 tons of crude ore sent direct to the smelters were recovered $3,238 in gold, 19,085 ounces of silver, 20,614 pounds of copper, and 671,840 pounds of lead—an average per ton of gold, $3.97; silver, 23.4 ounces; copper, 1.26 per cent; and lead, 41.17 per cent. The placers and siliceous ores produced the largest portion of gold and the lead ore the largest part of silver. The table shows that the gold and silver from placer production increased and that gold from siliceous ores decreased, while silver increased, as it also did in lead ore. In the copper ores the gold increased and the silver decreased.

Carmen Creek district.—The Oro Cache Mining Company, equipped with an amalgamation mill treating 15 tons of ore daily, operated during 1907 and produced some gold and silver bullion.

Eureka district.—The Moose Creek dredge, located above the junction of Moose and Daly creeks, was in operation part of the season, and prospected for a distance of 100 feet in width and within a short distance of the McNutt pump. The gold in this vicinity has an average fineness of about 0.930. The U. P. and Burlington Mining Company operated a 15-stamp plate-amalgamation mill. Ten stamps in the mill were in operation during the season, and some bullion was produced.

Forney district.—The Rabbit Foot Mining Company has developed its property with an adit 1,400 feet long, with raises to the surface. Ore tests were made during the latter part of the year in a 10-stamp plate-amalgamation mill, which is owned by the company. The Oregon-Idaho Gold Mining Company, with an incline shaft 300 feet deep and drifting aggregating 2,200 feet, operated its 50-ton milling plant. A small amount of bullion was produced.

Gibbonsville district.—The American Development, Mining, and Reduction Company, owning the Gibbonsville group of claims, operated its milling plant and produced an important amount of gold and silver bullion. In October the mill was lost by fire and is being rebuilt. Placer operations by hydraulicking and sluicing were carried on by a number of individuals. The most important work is that done on the Bohannon Bar placers. The gold here averages about 0.850 in fineness and is valued at $17.57 per crude ounce. Development work was performed by the Bingham Placer Mining Company (Limited), in this district.

Indian Creek district.—The Kittie Burton Mines Company operated its 15-stamp mill, equipped for amalgamation, until July, 1907. Development work only is being carried on at the present time in its Ulysses property, which has been exhausted of its oxidized free-milling gold ore. In the lower levels deposits of massive iron sulphide, containing about the usual average content of gold and some copper sulphides, have been encountered that will necessitate a change in ore treatment.

Junction district.—The Junction Mines Company, operating the Leadville group of claims, located in Lemhi Valley, is developed to a depth of 121 feet, with drifts aggregating 1,000 feet. The ore produced is carbonate and sulphide of lead. The shipment made contained 56 per cent of lead, 45 ounces of silver, and $2 in gold per ton.

Kirtley Creek district.—The Tin Doy Mining Company (Limited), owns the Tin Doy No. 1, in Eureka district, and the White Horse mine, in Kirtley Creek district, formerly operated by the Searchlight Mining Company. The small amalgamation mill, located on the property, was operated a short time. Plans were projected for a cable tram to connect a new mill site with both properties.

Leesburg district.—The principal placer operations were by the Ole Johnson Placer Mining Company and the Napias Placer Mining Company. The latter company has carried on operations by sluicing and drift mining. The company intends to install a dredge during 1908.

Mackinaw district.—The Lemhi Bitter Root Mining Company, developing the Italian and John Thompson claims, operated during part of the year the 10-stamp amalgamation mill on ore from the property. The Gold Ridge Mining Company devoted a large part of the year to the erection of a mill and development work in the mine. The drifts on the property will aggregate 1,400 feet. The mill is of 10 stamps, with a 50-ton cyanide plant. Several test lots of ore were treated in the mill before the year closed. It is understood that this company will acquire the Napias Creek Falls and erect a 1,000-horsepower electric plant. This will supply power for mining and milling operations, which at the present time can only be had by water power at the mill during a short season of the year. The Big Creek Gold Mining and Milling Company operated on an ancient river bed by drift mining. The gold in this district will average in fineness about 0.900, 87 per cent of the remainder being silver.

Mineral Hill district.—No important operations were reported from this district, and the only production recorded was from the Clipper Bullion property, aside from some gold produced by placer operators.

Pratt Creek district—The Climax group, on which there is a 10-stamp mill, equipped with Frue vanners, was in operation during the year. The mine is developed by a vertical shaft 230 feet deep, and has a tunnel 300 feet long.

Spring Mountain district.—Over 100 tons of lead-silver ore were shipped from the district, some of which assayed 71 per cent of lead, 48 ounces of silver, and $5 in gold. The principal operator was the Lemhi Union Mining Company. A shaft 120 feet deep has been sunk on the vein, which is 4 feet wide at the contact of a porphyry dike and limestone.

Texas district.—The Silver Dollar group, operated by the Pittsburg-Idaho County (Limited), continued to be the most important producer, and shipped a lead-silver concentrate and crude ore direct from the stopes to Utah smelters. The development is through a vertical shaft sunk 400 feet at the adit level, which is in a zone of altered blue and gray limestone. The ore mined in 1907 came from the 200 and 300 foot levels, taken from a flat dipping vein, ranging from 6 inches to 16 feet wide. Shipments to the railroad, 80 miles distant, were continued by the traction equipment inaugurated in 1906, but on account of a number of breakages, disabling the entire outfit, the old method of wagon haulage by team was used until October, when the property closed down on account of low prices of metals.

Parker district.—The Parker Mining Company's property is developed by a level run from the surface 200 feet long, with stopes from the level. Principally development work has been carried on during the year, but a small quantity of crude ore was shipped to the smelter.

Unorganized district.—The Copper Queen Mining and Smelting Company has developed its shaft to a depth of 350 feet. It is equipped with a 5-stamp, plate-amalgamation mill, with concentrators. This company is also developing the Queen and Crescent group of claims in the Eureka mining district. The new property is worked by an adit 1,000 feet long, which taps the vein at a depth of 400 feet. The ore is principally gold, containing some silver. The ore shipped from the Copper Queen property contained copper, gold, and silver.

Yellow Jacket district.—The Yellow Jacket Mining Company was the only operator on stream gravel deposits, which were worked by hydraulic methods.

LINCOLN COUNTY.

Snake River district.—The Good Luck and Salmon Falls placers were producers of small amounts of gold.

NEZ PERCE COUNTY.

One deep mine and 29 placers in 1907, against 4 deep mines and 34 placers in 1906, yielded an output valued at $54,848, an increase of $5,279 over that of 1906. The placer output for 1907 came largely from the operations of one dredge, and is valued at $54,584, an increase of $15,824 over the yield of 1906.

Burnt Creek district.—The operations in this district are principally placer. The most important productions were made by the Boise Placer Mining Company and the Venus Placer Mining Company, both of which were operated by hydraulic mining and sluicing.

Pierce district.—The Crescent mine carried on active development work during the year and made several trial shipments. The property is well developed, the shaft being at a depth of 201 feet and a surface drift has been driven 324 feet. The property is equipped with a 5-stamp amalgamation mill and a sawmill. Placer mining continues to be the chief industry in the district, and until recently the operations have been carried on entirely by hydraulic mining, but now the most important production is made by dredging, while other productions are secured through hydraulicking, sluicing, and the Ruble elevator. The dredge is the property of the Idaho Company (Limited), and the first and most succesful use made of the Ruble hydraulic elevator was by the American Placer Mining Company. The bullion in the district averages 820 in gold and 160 in silver.

ONEIDA COUNTY.

Snake River district.—The Daylight placers, near Neeley, continue to be the largest producers of gold bullion. The fineness of the gold in this district averages 0.930, and the value is $19.22 per crude ounce. The gold is produced by rockers and sluicing.

OWYHEE COUNTY.

The metallic product from the mines and mills of Owyhee County in 1907 showed an increase in gold, silver, copper, and lead, as well as in the tonnage. The latter amounted to 47,020 tons, as compared with 27,034 tons in 1906, while the average value per ton was lowered from $25.45 to $18.68. Of gold, 17,151.40 fine ounces, valued at $354,551, and of silver 793,910 fine ounces, valued at $523,981, were produced from deep mines and with small quantities of copper and lead were valued at $879,279. The placer output amounted to 66.18 fine ounces of gold and 32 fine ounces of silver. The placer yield in 1906 was $2,156, while in 1907 it decreased to $1,389. The renewal of operations at the De Lamar mill, in Carson district, is responsible for the increase of the gold and silver output.

Carson district.—The De Lamar Company (Limited) operated its 100-ton cyanide mill during the greater part of the year and almost reached its former output of gold and silver bullion. For nearly two years experimental work and rebuilding the mill to treat a lower grade of ore reduced the annual output of bullion. It is reported that development work was continuously carried on during this time and that important disclosures in the mine have brought the grade of ore up to about $12.50 per ton. The company, in planning for a reduction of power cost, is installing equipment to connect with the Swan Falls hydro-electric power plant. The Trade Dollar Mining Company operated during the entire year its 20-stamp amalgamation mill, equipped for concentration. The mill averages per day about 40 tons of ore, from which bullion and a concentrate were extracted. The value of the ore was about $35 per ton and it was milled at a cost not exceeding $3 per ton. Development work in the mine amounted to 5,860 feet in 1907. The main adit under Florida Mountain, connected with the mill, is 11,000 feet long and is being continued. The motive power in the mine is electricity from the company's plant at Swan Falls. The Potosi Company (Limited) is developing its property with a shaft 300 feet deep and has a 5-stamp mill in course of construction. The property is expected to produce during 1908. The Village Blacksmith Mining Company treated some ore in the Addie mill and shipped a test lot to the smelter, which was taken out during development work. The Sunnyside mine is equipped with a 5-stamp amalgamation mill. The shaft on the property is 50 feet deep, and a drift run from the surface is 150 feet long. On a vein 2,000 feet to the west of the Trade Dollar vein, parallel to it for 6,000 feet, the Banner Mining and Milling Company has developed the mine to a vertical depth of 400 feet by a series of 3,700 feet of crosscut drifts run from the surface. Of this work 1,544 feet were driven in 1907. The characteristic minerals of the Trade Dollar vein are also found in the Banner property. The property is being equipped with a milling plant similar to the Trade Dollar mill. It will treat 30 tons of ore daily and will be in commission in 1908.

French district.—The Commoner mine, of the Security Mining Company, was developed during 1907, and one test shipment of ore was made.

South Mountain district.—This district, situated about 23 miles southwest of Silver City, was organized in 1871. The first mineral was discovered three years before in small veins, but as the ore was poor it was not followed up. In 1872 a blast furnace was built to smelt the lead ores then being found, but proved a failure. In 1874–5 the South Mountain Consolidated Mining and Smelting Company attempted the smelting of ores, and the bullion product of the mines, it is said, aggregated in value about $350,000. In 1876 the financial crisis and the failure of the Bank of California caused all the mines in Owyhee County to close. In 1907 a new company took an option on these properties of the South Mountain Company, and after spending about $20,000 in development and reaching a point where results were promising, the panic in 1907 brought further operations to an end. Several promising cappings of iron have led to exploration with results at one point of opening up a deposit of chalcopyrite with considerable sphalerite occurring in coarse crystals that can be easily separated by concentration. This rich copper-sulphide ore carries nodules of galena. The streak of this ore exposed was encountered at a depth of 50 feet. It is 5 feet wide and assays $70 per ton for its gold, silver, and copper content. The American Standard Mining and Milling Company, adjoining the South Mountain properties, did mainly development work on its property, which is opened by a drift 350 feet long. A 14-ton shipment of lead carbonate ore contained 908 ounces of silver, 13,645 pounds of lead, and a little gold, and had a gross value of $1,322.46.

Snake River district.—Since the larger operations have been discontinued on Snake River the work above Owyhee County on the river has increased. The aggregate output of gold for 1907 amounted, however, to only 38.35 ounces.

SHOSHONE COUNTY.

Production of gold, silver, and associated metals in Shoshone County, Idaho, in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold......fine ounces..	3,568.33	$73,764	3,118.49	$64,465	− 549.84	− $9,299
Silver............do....	7,944,205	5,322,617	7,266,725	4,796,039	− 677,480	− 526,578
Copper ....pounds..	6,393,940	1,234,030	7,199,648	1,439,929	+ 805,708	+ 205,899
Lead ....do....	252,022,196	14,365,265	229,442,987	12,160,478	−22,579,209	−2,204,787
Zinc.............do....	2,054,998	125,355	6,948,655	409,971	+ 4,893,657	+ 284,616
PLACERS.						
Gold......fine ounces..	621.28	12,843	833.55	17,231	+ 212.27	+ 4,388
Silver............do....	133	89	137	90	+ 4	+ 1
Total............	....	21,133,963	....	18,888,203	....	−2,245,760

Source of gold and silver in Shoshone County, Idaho, in 1906 and 1907, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Lead-zinc ore.	Total.
Gold...............	1906	621.28	637.27	405.00	2,470.02	56.05	4,189.62
	1907	833.53	87.45	383.18	2,575.27	72.60	3,952.03
Silver...............	1906	133.00	2,827.00	478,349.00	7,415,995.00	47,034.00	7,944,338.00
	1907	137.00	135.00	454,107.00	6,597,493.00	214,990.00	7,266,862.00

The metal output of this county came from the Coeur d'Alene region, which covers its principal mineral area. The production of gold, silver, copper, lead, and zinc in 1907 aggregated in value $18,888,203—less by $2,245,760 than the value of the output in 1906.

The tonnage of ore mined decreased 81,305 tons, and the average total value per ton dropped from $13.01 in 1906 to $12.24 in 1907. Reports of production were received from 23 deep mines and 10 placers in 1907. The ores mined amounted to 1,541,670 tons, of which 92.4 per cent was treated in concentration mills and the remainder shipped crude to smelters. Thirteen concentration mills were in operation, including 2 tailing plants, 2 gold and silver mills using amalgamation, and 1 leaching plant for copper ores. At concentration mills 1,406,876 tons of lead ore and tailings were treated, producing 225,798 tons of concentrates (6.2 into 1), which contained 2,639.16 ounces of gold, 5,488,946 ounces of silver, and 195,512,709 pounds of lead, and averaged per ton 24 cents in gold, 24.31 ounces of silver, and 43.29 per cent of lead. Copper was contained in 137,604 tons of lead ore treated in 3 concentration mills, producing 14,614 tons of concentrates, containing 60,030 pounds of copper and averaging 0.25 per cent per ton. The Snowstorm leaching plant treated 18,695 tons of siliceous copper ore by the sulphuric-acid method and produced 660 tons of precipitates, averaging 12 ounces of silver and 62.18 per cent of copper, an average extraction of 0.42 ounces of silver and 2.19 per cent of copper for each ton of crude ore treated. Zinc ore was produced in 2 mining districts from the concentration of 76,157 tons of ore, from which 18,016 tons of concentrate were saved, containing 6,948,655 pounds of zinc (estimated as recovered spelter). The gross content of the tonnage of concentrates produced in the Coeur d'Alene region aggregated in value $14,631,073, an average of $64.61 for each ton of concentrate, or $10.26 for each ton of crude ore and tailings handled by the concentrators. The crude ore shipped to smelters aggregated 116,078 tons, containing 442.22 ounces of gold, 1,769,852 ounces of silver, 6,318,813 pounds of copper, and 33,930,278 pounds of lead. The total gross value of the shipping ore was $4,239,310, showing an average value of $36.52 per ton. Of crude ore shipped to smelters 73.4 per cent was copper ore, siliceous in character, averaging 3.7 per cent of copper, and the balance shipped were sulphide lead ores, averaging 55 per cent of lead. The placer bullion consisted of 833.55 fine ounces of gold and 137 fine ounces of silver, produced partly by the operation of one dredge and partly by hydraulic and sluicing methods. The placers are all located on the north side in the vicinity of Murray. The lead-silver veins are found in 3 distinct groups:[a] (1) The Mullan lodes, including those of Mill Creek and Hunter Gulch, near Mullan; (2) the Canyon Creek lodes, including those near the towns of Burke, Mace, and Gem; and (3) the Ninemile Creek lodes, lying northwest of the crest of the narrow ridge that extends from Wallace to Tiger Peak. The veins of the lead-silver mines are, for the most part, of the fissure type. The ore is generally found in quartzite country rock and varies in width from a few feet up to 300 feet. Generally the ore bodies increase in width with depth, and often a mere stringer near the surface will turn out to be a very valuable vein with depth. The veins have a northwest and southeast strike and generally dip to the south or southwest. The ores include galena, generally carrying silver, sphalerite, and sometimes chalcopyrite. In the upper portions of the deposit, where the ground water has oxidized the original ore, are found lead carbonate and some native silver, especially in the Hercules mine, and sometimes pyromorphite. The gangue minerals are quartz, siderite, and pyrite. The copper deposits of any commercial value as far as known are found near Mullan. The principal mine is the Snowstorm. The copper veins have a southwest and northeast strike and dip from 70 to 80 degrees to the southwest. The topography of the district is such that all of the large mines are developed by tunnels run from the surface. The Bunker Hill and Sullivan mine has an adit that starts about a mile west of Kellogg and cuts the Marsh lode at a depth of 1,700 feet vertically from the surface and about 12,000 feet from the portal of the adit. The Morning mine, at Mullan, has its No. 6 adit completed, which is 10,000 feet long and through which all of the ore is handled. The lode is cut at a depth of practically 2,000 feet. An adit at the Hunter mine, more than 5,000 feet long, which also cuts the ore body about 2,000 feet below the surface outcrop, has just been finished. The Snowstorm Company is now driving an adit 4,000 feet long to tap a rich ore shoot which was encountered on the upper levels. The extensive development of the Monarch lead-silver mine, east of Murray, includes a 3,700-foot adit, which taps the main vein at a vertical depth of 1,380 feet.

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[a] Ransome, F. L., The geology and ore deposits of the Coeur d'Alene district, Idaho; Prof. Paper U. S. Geol. Survey No. 62, 1908, pp. 84–85. Bull. U. S. Geol. Survey No. 260, 1905, pp. 290–303.

Beaver district.—The Callahan mine was productive of an important tonnage of lead ore, containing silver and traces of copper. The Idora Mining Company is developing its property by 3 levels run from the surface to connect with the shaft. The company shipped ore containing lead and silver during 1907, taken out during development work. Placer operations by dredge, drift, and hydraulic mining were carried on and a production recorded amounting to 545.21 ounces. The average fineness of the gold is about 0.822, and it is valued at $16.99 per crude ounce. The most important producers were the Mascot Gold Mining Company, operating a dredge for a period of about 30 days, and the Black Hill Placer Company, operating hydraulic.

Eagle district.—The production of this district, aggregating 165.57 ounces of gold and 20 ounces of silver, came principally from placer operations. The principal operations were performed by the Grove and Walker Placer Mining Company and on the Eagle placer.

Hunter district.—The Snowstorm Mining Company was a regular producer of copper ore containing silver and traces of gold. The property is developed by a series of adit levels, Nos. 1, 2, and 3. No. 3 is 723 feet vertically below No. 2. The leaching ore, which is mainly a carbonate of copper, comes from No. 1 and No. 2 levels and contains 2.65 per cent of copper and 4.5 ounces silver. The ore in No. 3 level is a heavy sulphide. The vein is nearly vertical and is said to range in width from 20 to 75 feet. The leaching plant, having a capacity of 150 tons of ore in 24 hours, was in operation a greater part of the year. A large part of the ore goes direct to the smelters and is valuable as converter lining, as it contains an average of 90 per cent of silica. The Federal Mining and Smelting Company operated its Morning property nearly the entire year, and its product was almost entirely concentrate, which was shipped to the smelter. The Gold Hunter Mining and Smelting Company has driven its lower, or

No. 6, adit from the concentrating mill, a distance of 4,240 feet into the mountain. The first ore was encountered at 3,996 feet, and a section is reported to show: Eight feet of ore, 6 feet of waste, 5½ feet of ore, and 51.8 feet of waste; at this point a very rich grade of copper-ore, assaying over 1,000 ounces silver, averaged 6 inches in width; then again followed waste, 37 feet; ore, 12 feet; waste, 14.3 feet; ore, 7 feet; waste, 28 feet; and ore, 28 feet. From a third to one-half of the ore is shipping ore and the balance is a very good milling grade. The ore encountered recently in the adit for shipping grade will assay 30 to 50 per cent of lead, with 1 ounce of silver to each per cent of lead. The mill was closed on September 1 for repairs and did not operate during the balance of the year, due to the scarcity of cash with which to pay miners. The company has recently added a new 20-drill Ingersoll-Sargent compressor, electrically operated.

Lelande district.—The Hecla Mining Company has a vertical shaft 900 feet deep and connecting with it an adit level 1,000 feet long. An electric hoist, the only one in the district, is a converted steam hoist having a flat cable and a 300-horsepower motor, and capable of operating to a depth of 1,000 feet. The ore is hoisted to a landing 58 feet above the collar of the shaft, then dumped upon a 3-inch grizzly. A sorting belt allows the sorting of about 15 tons of shipping ore daily from 25 tons of waste. The mill ore, sized and freed from waste, amounts to 300 tons per day. The mine workings, including prospecting work, extend 3,000 feet east of the shaft. The principal changes in the mill, which is equipped with jigs, tables, and vanners, have been the installation of Callow screens and settlers. The screens supplant the old system of hydraulic sizing. The completed milling plant, above Burke, of the Hercules Mining Company, which was first put in operation in May, 1906, has added many changes since that time, and typifies the approved lead-silver milling methods in the Coeur d'Alenes. There are 2 bins, arranged the one for high-grade and the other for mill ore; the latter is transported by surface tramway to the mill. This ore averages 6.5 per cent in lead and 7 ounces of silver. The treatment of the ore involves the preliminary breaking in a Blake crusher, screening, crushing overcharge, treatment of screened and classified product on jigs of the Harz type, with subsequent regrinding of the coarse middling from the 2 bull jigs in Humphrey rolls, the fine milling in Sturtevant centrifugal rolls, and final grinding in a 6-foot Huntington mill. Fifteen Wilfley No. 5 tables and five 6-foot vanners are used for the first treatment, while 3 tables treat the Wilfley middlings, and a vanner the tailings. Beginning with January, 1907, experiments were made in saving the zinc. The concentrates were made on the second screens of the No. 20, No. 12, and No. 5 jigs, and they ran about 30 per cent in zinc and 12 per cent in lead, for which product the company found a market. Another change made was the installation of two 80-mesh Callow screens to size the fine product on the Huntington floor. There is an increasing tendency throughout the region for using sizers rather than classifiers for fine material destined for table or vanner treatment. The mill treated approximately 250 tons of ore per twenty-four hours, shipping daily nearly 40 tons of concentrate averaging between 50 and 60 per cent of lead and 50 ounces of silver per ton. The mill is constructed so that any unit may be shut down without affecting the remainder. The mill is run by six 3-phase induction motors, starting on 110 and running on 220 volts, the power coming on a 60,000-volt line from Spokane, a distance of about 100 miles. The Frisco Mining Company (Limited) develops its property by a 1,600-foot vertical shaft, connected with levels run to the surface. A 400-ton mill was formerly operated as a lead concentrator, but was equipped in 1907 to make a zinc concentrate as well. The ore from the mine averages about 15 per cent of zinc, 8 per cent of lead, and 6 ounces of silver per ton. The additions made to the mill for separating the lead and zinc product consist of 6 Callow screens, 7 circular settling vats, 10 Wilfley tables, and 1 Ding's magnetic separator. Some high-grade ore and a lead and zinc concentrate found a ready market. The Tamarack and Chesapeake Mining Company has an adit over 1,100 feet long, through which the property is developed. Exploration has been continued during 1907 and only such shipments of ore were made as development warranted. These aggregated in value $15,094. The Federal Mining and Smelting Company operated the Standard and Mammoth mine at Mace and the Tiger mine at Burke. The shaft on the Tiger mine is 2,200 feet deep, 200 feet of which was sunk in 1907. Drifting and crosscutting have resulted in opening up a body of excellent ore, in places 10 feet wide. The Stanley Consolidated Mining and Milling Company owns a group of claims, with an area of 175 acres, in Gorge Gulch, north of Burke. The principal mineral is antimony sulphide containing gold and silver. Two carloads were shipped in 1907, containing gold valued at $1,370.40, silver valued at $130.30, and antimony valued at $3,532.85. On the dump are 80 tons more of the same grade. The New Jersey mill, below Osborn, has been leased by the company, with the intention of making a concentrate out of the low-grade ore.

Placer Center district.—The Success Mining Company is equipped with a 200-ton wet concentration mill. Its product consists of a lead concentrate containing silver, and a zinc concentrate. The zinc output in 1907 was valued at $448,308, as against $228,802 in 1906. The Pittsburg Lead Mining Company, operating the California mine, develops the property by an adit 3,000 feet long driven on the concentrator level. The concentrator has a daily capacity of 200 tons. The shipments consisted of a lead-silver concentrate.

St. Regis district.—The Monitor Consolidated Copper Company produced copper ore, containing gold. The property of this company is situated on the crest of Bitter Root Mountains. Development is carried on by a shaft 400 feet deep.

Summit district.—The property of the Bear Top Mining Company is developed by a level driven from the surface, crosscutting the veins, and is equipped with a 60-ton concentrator. All of the machinery is run by water power. The company shipped crude ore and a concentrate containing lead and silver to the smelter. The Coeur d'Alene Mining Company, operating placers, shipped some gold and silver bullion taken out by hydraulic operations.

Yreka district.—The Last Chance mine, of the Federal Mining and Smelting Company, produced the usual high-grade lead and silver ore from an extensive deposit, which has been followed to the 1,700-foot level, where the ore is being extracted for a width of about 100 feet. The mill, which treats the second-class ore from this mine, is situated 4 miles distant at the Sweeny station on the Oregon

Railroad and Navigation Company. The mine and mill are connected by a spur over which are conveyed daily 500 tons of ore to the mill. The Bunker Hill and Sullivan Mining and Concentrating Company, during 1907, mined from its property 355,000 tons of ore, the greater portion of which was milled and shipped to the various smelters in the form of concentrate and crude ore. The concentrate amounted to 82,460 tons. The new auxiliary concentrator was built to work over the 1,000,000 tons of accumulated tailings stored near the main mill, and for re-treating part of the tailing product of the latter. The new plant has a capacity of 1,000 tons per 24 hours. It is equipped with 4 Huntington mills, Callow screens, and vats, 16 Frue vanners, and 24 Wilfley tables. The accumulated tailing is first treated in jigs without previous grinding, the jig product being ground in Huntingtons before final treatment. A new 500-ton mill to treat crude ore is under construction. The Kellogg adit is more than 2 miles long, and taps the famous Marsh ore shoot at a vertical depth of 1,700 feet and also furnishes easy access to the great Sullivan ore shoot. The New Jersey Mining and Milling Company, working the Kellogg group, operated a mill on its quartz property, making experiments on 200 tons of ore to determine the best method of treatment. The company owns placers also, and has been preparing for sluicing operations. The quartz property produces gold from a surface deposit. The Stewart Mining Company's property is developed by an adit 3,500 feet long. Its 150-ton concentrator was operated only a few days during 1907. Concentrates and crude ore, containing lead and silver and traces of gold and copper, were shipped to Montana and Utah. The Coeur d'Alene Consolidated Mining Company has extended its vertical shaft to a depth of 530 feet and its tunnel to a length of 545 feet. Crude ore, containing lead and silver, was shipped to the smelter as a test. The Nabob Mining Company developed its property by a shaft 365 feet deep and has over 2,600 feet of drifts. In crosscutting, it is reported that 3 feet of good shipping ore was encountered and an average of 5 feet of concentrating ore has been opened up on the 100-foot and 200-foot levels. The ore shipped to the smelter contained lead and silver. The Charles Dickens Mining Company made one shipment of concentrates. The company lost its mill by fire, and only development work has been carried on in the mine since.

TWIN FALLS COUNTY.

Snake River district.—From placer operations it is reported that 109.89 ounces of gold were produced.

WASHINGTON COUNTY.

Two deep mines and 1 placer yielded the output of this county, valued at $31,796. The total quantity of gold produced by deep mines was 61.14 ounces, valued at $1,264; of silver, 1,848 ounces, valued at $1,220; and of coppper, 146,400 pounds, valued at $29,280. The metals were contained in 544 tons of ore shipped to the smelters.

A comparison of these figures with those of 1906 shows that the tonnage decreased 2,218 tons and that the total value decreased $39,043. The quantity of gold produced in the county decreased 366 ounces in quantity and $7,566 in value; of silver, 7,957 ounces and $5,350 in value; and of copper, 128,867 pounds and $23,847 in value. In 1906 lead was produced amounting to 40,000 pounds, valued at $2,280, but no lead ore was shipped in 1907.

Seven Devils district.—The Lockwood and Peacock groups produced copper, carrying silver and gold values, which was mined by lessees. The ore from both properties was taken from surface cuts.

MONTANA.

By Charles T. Kirk.

PRODUCTION.

Reports from the 436 mines producing gold, silver, copper, lead, and zinc in Montana during the calendar year 1907 show that the total value of all these metals was $53,670,592 as against $69,257,083 in 1906. These totals include the 123 placer mines which produced $18,006 in gold and silver. The total quantity of gold amounted to 158,970.51 fine ounces, the value of which was $3,286,212, or a trifle more than 6 per cent of the State total value. The 9,317,605 fine ounces of silver were valued at $6,149,619, approximately 11.5 per cent of all values. The copper production of 220,108,792 pounds had a value of $44,021,758, or more than 82 per cent of the total value of metals. The combined values of the 3,748,304 pounds of lead and the 243,100 pounds of zinc amounted to $213,003, which is less than one-half of 1 per cent of all values.

The percentages of decrease in 1907 as compared with the values obtained in 1906 run as follows: Gold, 26.46; silver, 23.39; copper, 21.54; lead, 21.91; zinc, 96.43. The total decrease in value of metals for the State is 22.51 per cent.

In connection with these diminutions of production it is interesting to notice that the decrease in silver for Montana was 2,663,100 fine ounces, while for Silverbow County it was 3,199,062 fine ounces; similarly the decrease in copper for Montana was 70,592,183 pounds, while for Silverbow County it was 70,943,423 pounds. Obviously the gain in production of copper and silver in other counties has offset in part the loss in this one county. From these data may be seen the wholesale effect of the restriction of production in Silverbow County. Perhaps the relation will be clearer when it is known that the copper ores of this county yielded more than 76 per cent of the silver from deep mines in the State. The accompanying table compares the results of operations in the State for the two periods indicated. It is of interest to compare it in detail with a similar arrangement for Silverbow County on a later page.

Production of gold, silver, and associated metals, and their ores, in Montana in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease. (−)	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.........fine ounces..	216,188.56	$4,469,014	158,970.51	$3,286,212	− 57,218.05	−$1,182,802
Silver ....do.....	11,980,705	8,027,072	9,317,605	6,149,619	− 2,663,100	− 1,877,453
Copper ....pounds..	290,700,975	56,105,288	220,108,792	44,021,758	−70,592,183	−12,083,530
Lead ....do.....	4,462,979	254,390	3,748,304	198,660	− 714,675	− 55,730
Zinc...............do.....	6,579,000	401,319	243,100	14,343	− 6,335,900	− 386,976
Total value	....	69,257,083	....	53,670,592	....	−15,586,491
Ore output...short tons..	5,497,971	[a] 12.60	4,148,496	[a] 12.85	− 1,349,475	+ [a] .25

[a] Value per ton, placer product excluded.

GOLD.

In the production of placer gold there were notable increases in Beaverhead, Deerlodge, Granite, Lewis and Clark, and Powell counties. The yield from this source in Madison County shrank to about half the proportions of 1906, but was still considerably more than half of the placer total for the State.

Five counties in order of rank in production of gold from deep mines were Silverbow, Fergus, Lewis and Clark, Jefferson, and Chouteau. Fergus County led in the production from siliceous ores, Silverbow County from copper ores, Lewis and Clark County from lead ores, and Madison County from mixed ores. The average yield of gold from copper ores for the State was 17 cents; from the copper ores of Silverbow County it was 15.9 cents, nearly. The average for the State from siliceous ores was $5.34, and although the tonnage of these ores was low in comparison with that of copper ores the largest yield in gold belonged to siliceous ores. Other points of comparison may be derived from the following table:

Source of gold product in Montana, by kinds of ore, in 1907, by counties, in fine ounces.

County.	Placers.	Deep mines.					Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Mixed, chiefly copper-lead-zinc ores.	Total.	
Beaverhead	216.19	24.33	13.64	4.79	....	42.76	258.95
Broadwater	291.12	571.55	2,183.89	565.12	....	3,320.56	3,611.68
Cascade	....	533.81	....	42.14	....	575.95	575.95
Chouteau and Flathead....	258.71	13,026.42	....	....	....	13,026.42	13,285.13
Deerlodge	294.22	3,400.71	....	9.10	....	3,409.81	3,704.02
Fergus.......................	71.50	31,241.30	....	3.68	....	31,244.98	31,316.48
Granite......................	512.05	2,811.56	1.60	10.30	....	2,823.46	3,335.51
Jefferson	142.71	14,521.06	81.56	779.76	....	15,382.38	15,525.09
Lewis and Clark............	1,237.72	21,683.80	....	3,293.03	9.97	24,986.80	26,224.52
Madison	9,462.59	6,649.05	32.02	269.84	2,002.14	8,953.05	18,415.64
Meagher, Park, and Ravalli.	321.16	1,008.81	....	2.32	....	1,011.13	1,332.29
Missoula.....................	2,010.85	....	17.27	....	....	17.27	2,028.12
Powell.......................	1,181.61	2,381.16	....	1,426.77	....	3,807.93	4,989.54
Silverbow	866.35	1,877.52	28,442.10	58.63	3,122.99	33,501.24	34,367.59
Total	16,866.77	99,731.08	30,772.08	6,465.48	5,135.10	142,103.74	158,970.51

SILVER.

In the production of silver from placers Madison County ranked first, as in the yield of gold from the same source. From the totals it appears that the silver content of the placer product of Madison County was high, and that the ratio of silver to gold in the same product from Missoula County was very low.

On account of the heavy tonnage of copper ores their average yield in silver of even less than 2 ounces per ton threw the balance largely in their column. In total production of silver Jefferson County ranks second only to Silverbow County; the total silver from the former county has risen in rank above both Cascade and Granite counties since 1906. The table given herewith accounts for the sources of silver in the ores of the different counties.

Source of silver product in Montana, by kinds of ore, in 1907, by counties, in fine ounces.

County.	Placers.	Deep mines.					Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Mixed, chiefly copper-lead-zinc ores.	Total.	
Beaverhead	22	33,450	14,189	19,795	...	67,434	67,456
Broadwater	45	3,521	85	7,541	...	11,147	11,192
Cascade	...	117,295	...	79,829	...	197,124	197,124
Chouteau and Flathead	15	16,835	...	...	...	16,835	16,850
Deerlodge	33	704	...	340	...	1,044	1,077
Fergus	189	2,786	...	655	...	3,441	3,630
Granite	138	436,797	4,639	14,522	...	455,958	456,096
Jefferson	24	674,749	18,333	82,053	...	775,135	775,159
Lewis and Clark	438	65,293	1,412	96,849	1,484	165,038	165,476
Madison	1,569	67,535	...	1,694	3,034	72,263	73,832
Meagher, Park, and Ravalli	40	236	87	6,160	...	6,483	6,523
Missoula	89	...	5,924	103	...	6,027	6,116
Powell	160	11,641	...	8,614	...	20,255	20,415
Silverbow	147	266,203	7,118,419	10,230	121,660	7,516,512	7,516,659
Total	2,909	1,697,045	7,163,088	328,385	126,178	9,314,696	9,317,605

COPPER.

The reported intention of the leading copper producers of the State to restrict the production of that metal for the year 1907 to 70 per cent of normal was hardly fulfilled. The yield in pounds for 1907 was 220,108,792, which is a little more than 75 per cent of the 290,700,975 pounds of 1906, and a little more than 72 per cent of the yield of 1905. The value of the metal produced in the State in 1907 was $44,021,758; and for 1906, $56,105,288. Owing to the slightly higher average price for 1907 the ratio of decrease in value from the high mark of 1906 was not so large as that of decrease in pounds. The returns of production showed an improvement in Broadwater and Missoula counties, creditable to the Eclipse-Argo mine in Broadwater County and to the Hidden Treasure, Cape Nome, and Triangle mines in Missoula County. Four counties in order of importance of production are Silverbow, Broadwater, Jefferson, and Beaverhead; none of these showed a production of less than 125,000 pounds.

LEAD.

The lead totals for Montana in 1907 were 3,748,304 pounds, giving a value of $198,660. The yield in 1906 was 4,462,979 pounds, valued at $254,390. There were decreases in all counties except Deerlodge, Jefferson, Lewis and Clark, and Missoula. The first and last named counties, however, did not report lead in 1906. In Jefferson County there was the marked increase from 811,616 pounds in 1906 to 1,414,952 pounds in 1907; in Lewis and Clark County there was the proportionately large gain from 522,248 pounds in 1906 to 1,000.337 pounds in 1907. In the latter county the lead ores were the chief source of silver, and an important source of gold. In Beaverhead, Cascade, Granite, and Jefferson counties also the lead ores yielded largely in silver.

ZINC.

Little zinc was recovered from the ores of the State. The total yield for 1907 was 243,100 pounds, valued at $14,343. The yield for 1906 was 6,579,000 pounds, worth $401,319. In many districts there are paying quantities of the metal, but mills for its profitable separation have not been perfected. Notable among the possible zinc-producing counties are Jefferson, Lewis and Clark, Madison, Powell, and Silverbow. Electrostatic experiments are in progress on the making of a zinc concentrate from the ores of the northern portion of the Summit Valley district at Butte.

Production of gold, silver, copper, lead, and zinc in Montana in 1907, by counties.

County.	Gold.				Silver.	
	Placer.		Deep mines.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Fine ounces.*	
Beaverhead	216.19	$4,469	42.76	$884	67,456	$44,521
Broadwater	291.12	6,018	3,320.56	68,642	11,192	7,387
Cascade	....	....	575.95	11,906	197,124	130,102
Chouteau and Flathead	258.71	5,348	13,026.42	268,280	16,850	11,121
Deerlodge	294.22	6,082	3,409.81	70,487	1,077	711
Fergus	71.50	1,478	31,244.98	645,891	3,630	2,396
Granite	512.05	10,585	2,823.46	58,366	456,096	301,023
Jefferson	142.71	2,950	15,382.38	317,982	775,159	511,605
Lewis and Clark	1,237.72	25,586	24,986.80	516,523	165,476	109,214
Madison	9,462.59	195,609	8,953.05	185,076	73,832	48,729
Meagher, Park, and Ravalli	321.16	6,639	1,011.13	20,902	6,523	4,305
Missoula	2,010.85	41,568	17.27	357	6,116	4,037
Powell	1,181.61	24,426	3,807.93	78,717	20,415	13,474
Silverbow	866.35	17,909	33,501.24	692,532	7,516,659	4,960,995
Total	16,866.77	348,667	142,103.74	2,937,545	9,317,605	6,149,619

Production of gold, silver, copper, lead, and zinc in Montana, etc.—Continued.

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Beaverhead	129,195	$25,839	88,239	$4,677			$80,390
Broadwater	660,152	132,030	143,570	7,609			221,686
Cascade			355,720	18,853			160,861
Chouteau and Flathead							285,749
Deerlodge	8,848	1,770	4,106	218			79,268
Fergus	1,219	244	52,519	2,783			652,792
Granite	44,311	8,862	71,237	3,776			382,612
Jefferson	238,822	47,764	1,414,952	74,992			955,293
Lewis and Clark	27,367	5,473	1,000,337	53,018			709,814
Madison	33,854	6,771	90,037	4,772			440,957
Meagher, Park, and Ravalli	40,800	8,160	130,000	6,890			46,896
Missoula	86,200	17,240	9,000	477			63,679
Powell	1,397	279	164,911	8,740			125,636
Silverbow	218,836,627	43,767,325	223,676	11,855	243,100	$14,343	49,464,959
Total	220,108,792	44,021,758	3,748,304	198,660	243,100	14,343	53,670,592

MINING INDUSTRY IN MONTANA IN 1907.

The high prices for metals in 1906 had stimulated the mining industry of Montana to a high degree of activity. New companies had been organized by the score, and energetic development work was in progress in many parts of the State. The year 1907 opened auspiciously, and under the influence of rising copper prices the activity continued unabated until September. The numerous new enterprises for copper had little effect on the production of any county. Some of the old copper-producing mines were reopened, however, and worked to advantage during the months mentioned. The mines of the Clinton district of Missoula County, the Eclipse-Argo mine in Broadwater County, and the Boulder mine in Jefferson County are among those which resumed operations.

By the middle of September, however, the price of copper had fallen so low as to cause the Amalgamated Copper Company to restrict the output from most of its mines. It was thought that this order, which threw out of employment so many of the miners of Butte, would be of aid to the mining industry in other counties, but the effect was apparent only upon the number of producing placer mines.

The financial panic of October made itself felt severely in Montana. The first effect was in the closing of the smelters. In November the smelters announced that they would receive no more custom ore. The East Helena lead smelter, however, still accepted ore from mining companies with which contracts had previously been made. Although some ore was shipped to Utah points, this decision affected the small mine operations adversely. Early in December the Washoe smelter was closed. Later, in the middle of December, the smelter again began to take custom ore. The mines of the Amalgamated Company were closed, except those of the Boston and Montana. The smelter of the latter company at Great Falls continued in operation to the end of the year. Many mining companies in various parts of the State were forced to close from lack of ready money, and there was little relief from these conditions up to the end of the year. Further discussion of the smelting industry is found under the heading of Silverbow County.

The following table shows the number of mines operating. There were 436 producing mines in 1907, against 370 in 1906. The number of placer mines in 1907 was 131, almost double that of 1906. The producing deep mines numbered 305 in 1907, against 308 in 1906:

Number of mines in Montana classified by chief product in 1907, by counties.

County.	Placers.			Deep mines.								Total mines producing.
	Hydraulic and surface.	Drift.	Dredge.	Gold.	Silver.	Copper.	Gold-silver.	Gold-silver-lead.	Silver-copper.	Silver-lead.	Total.	
Beaverhead	4	1	....	......	2	2	1	[a] 1	....	[b] 5	11	16
Broadwater	11	1	....	6	....	1	[c] 3	[d] 8	....	1	19	31
Cascade	......	....	....	1	2	....	2	6	....	6	17	17
Chouteau and Flathead	2	....	....	1	....	....	1	......	....	......	2	4
Deerlodge	5	....	....	[c] 6	....	....	1	2	....	......	9	14
Fergus	2	....	....	1	....	....	3	......	....	2	6	8
Granite	9	....	....	4	3	1	5	[a] 2	1	[e] 5	21	30
Jefferson	8	1	....	1	1	....	11	[f] 17	2	2	34	43
Lewis and Clark	21	....	....	18	....	....	5	[g] 13	....	2	38	59
Madison	14	....	1	21	1	....	[c] 21	[dh] 6	....	1	50	65
Meagher, Park, and Ravalli	8	2	....	2	....	1	......	......	....	1	4	14
Missoula	11	1	....	......	....	....	......	......	3	1	4	16
Powell	26	....	1	......	....	....	5	[i] 5	....	......	10	37
Silverbow	2	....	....	1	2	51	9	[gj] 5	11	1	80	82
Total	123	6	2	62	11	56	67	65	17	27	305	436

[a] 1 gold-silver-copper mine.
[b] 3 silver-copper-lead mines.
[c] 1 gold-copper mine.
[d] 1 gold-silver-copper-lead mine.
[e] 2 silver-copper-lead mines.
[f] 3 gold-silver-copper-lead mines.
[g] 1 gold-silver-copper-lead-zinc mine.
[h] 1 gold-silver-copper-zinc mine.
[i] 1 gold-silver-lead-zinc mine.
[j] 2 gold-silver-copper mines.

An analysis of the tonnage and values from the deep mines shows that for all metals the gain in value per ton was from $12.60 in 1906 to $12.85 in 1907, or 25 cents per ton in favor of the year 1907, in which the lower total tonnage was produced. It is curious to observe, however, that the average value in gold and silver was only increased from $2.18 per ton in 1906 to $2.19 in 1907. A prominent rise in these respects is noticeable in Cascade and Powell counties. In Beaverhead County there was a sharp decline in average value per ton of base metals. The heavy decreases in tonnage in various counties was somewhat offset by the increase of several thousand tons from Chouteau and Flathead, Granite, and Jefferson counties. Other comparisons of interest may be seen in the table below.

Tonnage of ore sold or treated, number of mines producing, and average value per ton of ores in Montana in 1906 and 1907, by counties.

County.	Short tons of ore sold or treated.		Mines producing (without placers).		Average value per ton.		Average value per ton in gold and silver.	
	1907.	Increase (+) or decrease (−).	1906.	1907.	1906.	1907.	1906.	1907.
Beaverhead	1,613	+ 83	11	11	$67.18	$47.05	$26.99	$28.14
Broadwater	15,261	+ 142	19	19	13.66	14.13	12.21	4.98
Cascade	3,897	− 4,496	14	17	28.19	41.28	24.31	36.44
Chouteau and Flathead	50,050	+ 5,047	3	2	6.30	5.60	6.29	5.60
Deerlodge	7,662	− 9,604	3	9	6.47	9.55	4.88	9.29
Fergus	162,717	− 65,717	6	6	4.52	4.00	4.50	3.98
Granite	16,652	+ 1,693	24	21	25.12	22.33	23.18	21.57
Jefferson	41,829	+ 21,198	50	34	21.89	22.77	17.27	19.84
Lewis and Clark	95,277	− 1,160	43	38	6.55	7.18	6.14	6.56
Madison	11,818	− 8,679	60	50	19.04	20.67	17.00	19.69
Meagher, Park, and Ravalli	1,814	+ 896	3	4	12.07	22.18	8.74	13.88
Missoula	609	+ 200	3	4	35.26	36.21	8.16	7.12
Powell	3,951	− 5,176	8	10	8.86	25.59	7.58	23.32
Silverbow	3,735,346	−1,283,888	60	80	12.91	13.24	1.68	1.51
Total	[a]4,148,496	−1,349,475	308	305	12.60	12.85	2.18	2.19

[a] Sanders County reported production in 1906, but not in 1907; its items are omitted from this table, but its tonnage for 1906 is included in the total.

It may be seen from the table following that while the lead ores are richest in gold and silver their tonnage is lowest, and that the reverse is true of the copper ores. This table shows further that siliceous ores were reported from all counties except Missoula.

Subdivision of tonnage of ore sold or treated in Montana in 1907, by counties, in short tons.

County.	Siliceous ores.	Copper ores.	Lead ores.	Mixed, chiefly copper-lead-zinc ores.	Total.
Beaverhead	880	552	181		1,613
Broadwater	418	13,688	1,155		15,261
Cascade	2,123		1,774		3,897
Chouteau and Flathead	50,050				50,050
Deerlodge	7,637		25		7,662
Fergus	162,587		130		162,717
Granite	15,742	401	509		16,652
Jefferson	37.427	1,625	2,777		41,829
Lewis and Clark	89,460	28	5,775	14	95,277
Madison	7,126	8	155	4,529	11,818
Meagher, Park, and Ravalli	1,512	102	200		1,814
Missoula		594	15		609
Powell	3,098		853		3,951
Silverbow	8,180	3,702,602	812	23,752	3,735,346
Total	386,240	3,719,600	14,361	28,295	4,148,496
Decrease	94,603	1,244,156	6,373	4,343	1,349,475
Average value per ton in gold and silver	$8.24	$1.43	$24.40	$6.69	$2.19

A division of the total tonnage of the State into ore to gold and silver mills, ore to concentrators (with concentrates produced), crude ore direct to smelters, and old tailings treated, together with the value of gold and the fine ounces of silver from each class of ore, is shown in the table following:

Tonnage of milling and smelting ore and concentrates, with value of gold and quantity of silver contained in bullion, produced in Montana in 1907, by counties.

County.	Ore to gold and silver mills.			Ore to concentrating mills.	Concentrates produced.		
	Quantity.	Gold in bullion.	Silver in bullion.		Quantity.	Gold.	Silver.
	Short tons.		*Fine ounces.*	*Short tons.*	*Short tons.*		*Fine ounces.*
Beaverhead	91	$99	77				
Broadwater	120	1,180	10	9,342	977		
Cascade							
Chouteau and Flathead	50,050	267,675	16,835				
Deerlodge	4,642	39,032	695				
Fergus	160,586	640,280	2,719	2,000	2	$4,675	35
Granite	125	2,907	43	1,028	114	1,210	20,475
Jefferson	7	32	334	13,000	1,114	11,124	130,688
Lewis and Clark	45,519	347,312	6,978	8,597	860	24,861	3,484
Madison	3,321	36,491	946	5,360	637	37,601	14,341
Meagher, Park, and Ravalli							
Missoula							
Powell	350	36,176	400	1,450	160	4,882	3,290
Silverbow				3,334,639	1,229,438	423,164	5,531,558
Total	264,811	1,371,184	29,037	3,375,416	1,233,302	507,517	5,703,871
Per ton		5.18	.11			.41	4.62

County.	Crude ore to smelter.			Old tailings treated.	
	Quantity.	Gold.	Silver.	Quantity.	Value in gold and silver.
	Short tons.		*Fine ounces.*	*Short tons.*	
Beaverhead	1,522	$785	59,699		
Broadwater	5,744	66,969	10,877	55	$665
Cascade	3,519	11,906	191,299	378	3,844
Chouteau and Flathead	50	1,605			
Deerlodge	1,349	20,693	349	1,671	10,762
Fergus	130	76	655	1	881
Granite	15,499	54,248	435,440		
Jefferson	28,821	306,827	644,114		
Lewis and Clark	7,195	86,805	105,928	33,966	89,655
Madison	3,137	111,046	56,101		
Meagher, Park, and Ravalli	314	172	6,247		
Missoula	609	357	6,027		
Powell	1,151	37,658	16,565		
Silverbow	327,526	264,371	1,911,146	45,182	57,956
Total	396,566	963,518	3,444,447	81,253	163,763
Per ton		2.43	8.69		2.01

REVIEW BY INDIVIDUAL COUNTIES.

BEAVERHEAD COUNTY.

Production of metals and their ores in Beaverhead County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold ... fine ounces	107.39	$2,220	258.95	$5,353	+ 151.56	+ $3,133
Silver ... do	58,561	39,236	67,456	44,521	+ 8,895	+ 5,285
Copper ... pounds	246,841	47,640	129,195	25,839	− 117,646	− 21,801
Lead ... do	243,022	13,852	88,239	4,677	− 154,783	− 9,175
Total value		102,918		80,390		− 22,558
Ore output ... short tons	1,530	[a] 67.18	1,613	[a] 47.05	+ 83	− [a] 20.13

[a] Value per ton, placer product excluded.

Beaverhead County includes some of the districts which have recently enjoyed a revival of industry in gold and silver mining. The French Brothers have reported a new mine, the Summer Day, in the Argenta district; the old Kent mine in the Blue Wing district has taken on a new lease of life; the Indian Queen mine, of the Utopia district, still continues operations under bond. The Silver Fissure mine, one of the oldest properties in the county, has been equipped with a new smelting plant of 4 blast furnaces, which will be able to handle its own and some custom ores. The ore from this mine is extracted by tunnels. The New Departure mine still remains one of the heaviest shippers of the county. In this county is the site of the first dredges of Montana, but placer mining is now confined to a few gulches worked mainly by sluicing. These workings in 1906 showed a production of only $176; in 1907 they yielded gold and silver valued at $4,483.

BROADWATER COUNTY.

Production of metals and their ores in Broadwater County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold........fine ounces..	7,581.48	$156,723	3,611.68	$74,660	−3,969.80	− $82,063
Silver........do....	47,853	32,061	11,192	7,387	− 36,661	− 24,674
Copper........pounds..	7,096	1,370	660,152	132,030	+ 653,056	+ 130,660
Lead........do....	359,889	20,514	143,570	7,609	− 216,319	− 12,905
Total value........	....	210,668	....	221,686	....	+ 11,018
Ore output........short tons..	15,119	[a]13.66	15,261	[a]14.13	+ 142	+ [a]0.47

[a] Value per ton, placer product excluded.

A noticeable feature in the mineral production of Broadwater County is the increase in copper from 7,096 pounds in 1906 to 660,152 pounds in 1907. This was due to the energetic working of two or three mines not hitherto well managed. The total tonnage of ores was increased a little, the value per ton being also enhanced. Considerable development work was spent on the Argo, Park New Era, Uffle, Blacker, and Broadwater mines. While the number of operating deep mines remained the same, their total value increased $11,017, or nearly 5 per cent.

This county is developing its placer resources very rapidly, the number of placer producers having more than doubled during 1907. A dredge is projected for Confederate Gulch, formerly a famous sluicing placer ground, near Diamond City; still another dredge owned by the same company will be put on the bench gravel of the Missouri River, just below Toston.

Beaver Creek district.—This district ranked third in tonnage from Broadwater County in 1907, its 857 tons carrying values chiefly in gold, with paying quantities in silver and lead. The Custer mine shipped largely to the East Helena smelters.

Hellgate district.—Three-fifths of the tonnage of the county in 1907 came from Hellgate district. The Argo mine was the heaviest shipper, sending both crude ore and concentrates to the East Helena and the Washoe smelters. This is one of the few copper mines of the eastern mining region of Montana.

Park district.—The Park district is the second in importance of the county, and produces the same metals—gold, silver, copper, and lead. The values in the Park district, however, come principally from gold, and average one-third higher per ton than those of the Hellgate district. The tonnage is only one-half of that of the Hellgate district, The Blacker mine was under lease to the East Helena smelters during 1907, as was also the Keating, of the Cedar Plains district. Other mines of important production for the year include the Park New Era and the John L. The number of mines reporting in the district has increased from 3 in 1906 to 10 in 1907.

CASCADE COUNTY.

Production of metals and their ores in Cascade County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold ....fine ounces..	324.46	$6,707	575.95	$11,906	+ 251.49	+$5,199
Silver......................do....	294,556	197,352	197,124	130,102	− 97,432	−67,250
Copper ....pounds..	360	70	....	....	− 360	− 70
Lead ....do....	569,046	32,436	355,720	18,853	−213,326	−13,583
Total value	....	236,565	....	160,861	....	−75,704
Ore output...........short tons..	8,393	[a]28.19	3,897	[a]41.28	− 4,496	+[a]13.09

[a] Value per ton.

The mining industry of Cascade County is now limited to the valley of Belt Creek, in the Little Belt Mountains, and centers about the town of Neihart. The yield from this region is chiefly in silver and lead, but on Snow Creek, over the range to the east, gold is present in recoverable quantities. Development has been carried on recently in the old Johannesburg camp, 5 miles below Neihart, where also gold values are more prominent.

Montana district.—The region about Neihart produced a low tonnage during 1907, partly because of the low price of silver, and also on account of destructive washouts on the Neihart branch of the Great Northern Railway. The latter circumstance cut off shipping facilities for a great part of the summer season. The decrease of more than one-half the tonnage from the record of 1906 was accompanied by an increase of nearly one-half in value per ton. More gold was produced in 1907 than in 1906 in this district, but the quantities of silver and lead decreased in their respective units of weight about equally.

The Florence mine, the Galt mine, and the Broadwater mines were worked in 1907 by lease. The Broken Hill mine is worked through the shaft of the Broadwater group. The mines of the district generally are worked by adit tunnels. Development to the extent of from 100 feet to 200 feet was carried on in the Silver Belt, Big Seven, Ripple, Lizzie, and others. Most of the ores go to East Helena, but some producers ship to the United States smelters at Salt Lake, Utah.

CHOUTEAU COUNTY.

Little Rockies district.—The one mining region of Chouteau County yields only gold and silver. It is known as the Little Rockies district, and lies near Zortman, some 55 miles south of the nearest station, Malta, on the Great Northern Railway. Since the ores yield only gold and silver, however, and are amenable to the cyanide treatment, they are profitably mined and treated even in this isolated location. The ore bodies are (1) zones of fractured porphyry replaced and cemented by quartz and pyrite, and (2) replacement deposits in limestone near intruding porphyry.[a] Operations are conducted altogether by tunneling. The Alabama mine and the Fergus mine have 1,100 feet and 1,200 feet of development, respectively, while the Alder Gulch and the Ruby Gulch each have 900 feet. The Alder Gulch was closed during the year 1907, but began producing again early in 1908. In the meantime its 100-ton cyanide mill has been strengthened and improved. The ore is extracted partly by open cuts and partly by tunnels, going part way by train and part way by team to the mill. This mine and the Ruby Gulch, which has been in constant operation, are the principal producers of the district. The cyanide mill on the latter property has been enlarged to accommodate the increasing output of ore. Still further arrangements are being made to work by open cuts certain high-grade surface deposits said to have been discovered on the claims of the company. The values in the district average from $5 to $7 per ton for all mines, with three-fourths of the total returns coming from the gold.

DEERLODGE COUNTY.

The number of producing deep mines in this county increased from 3 in 1906 to 9 in 1907, and during the same time the ore treated increased 9,604 tons, or 60 per cent. The average value per ton shows a marked increase for 1907, but suffices to bring the total value of all metals to only 65 per cent of their aggregate for 1906. The placer production of the county was nearly doubled, while the number of workings increased from 1 in 1906 to 5 in 1907. Further increase is probable for 1908, since a dredge is being installed on Cottonwood Creek.

Georgetown district.—This region, lyinging to the west of Anaconda, is the most important of the county. Besides the Cable, Gold Coin, and Southern Cross mines of former years, the Orphan Boy and the White Syndicate mines were operated in 1907. The former has 3 vertical shafts of about 100 feet each, with about 200 feet of levels, and is equipped with a 30-ton steam stamp mill with plate amalgamation and cyanide tanks. The Cable and the Gold Coin mines have equipments of capacities equal to that of the Orphan Boy, while at the Southern Cross a 100-ton cyanide plant with the Moore slime process has been installed during the year 1907. Some of the ore from the Cable mine averages about 4 per cent copper, which is recovered at the Washoe smelters. This mine has more than 7,000 feet of workings. The copper discoveries in it are of comparatively recent occurrence.

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[a] Emmons, W. H., gold deposits in the Little Rocky Mountains, Montana; Bull. U. S. Geol. Survey; No. 340, 1908, pp. 76–96.

Heber district.—The Olive May and the Spain quartz mines were light shippers from the Heber district. This region and the Gold Creek district yielded fair returns from placers.

FERGUS COUNTY.

Production of metals and their ores in Fergus County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold, ...fine ounces..	49,577.89	$1,024,866	31,316.48	$647,369	−18,261.41	−$377,497
Silver ....do....	2,997	2,008	3,630	2,396	+ 633	+ 388
Copper ....pounds..	3,318	641	1,219	244	− 2,099	− 397
Lead ....do....	100,914	5,752	52,519	2,783	− 48,395	− 2,969
Total value	....	1,033,267	....	652,792	....	− 380,475
Ore output........short tons..	228,434	[a] 4.52	162,717	[a] 4.00	65,717	− [a] 0.52

[a] Value per ton.

The returns for 1907 show a decrease of $380,475 in the total output of metals from Fergus County. This represents a decrease of nearly 37 per cent from the yield of 1906. More than 99 per cent of the values are won from siliceous ores and occur in gold and silver. Two of the 6 producers reported small shipments of lead ore carrying some copper. The ores occur generally in the laccolithic contacts of the Judith and the North Moccasin mountains, and may be mined largely by open cuts. Besides the reduction in total value there were also reductions in tonnage and in average value per ton.

North Moccasin district.—An important affiliation was perfected in the North Moccasin district in 1907 between the owners of the North Moccasin and the Kendall mines. The electric plant and the 500-ton cyanide mill of the Kendall Company will be used to tram and treat the ores of the North Moccasin group. One of the companies has large bodies of low-grade ore, while the other has in sight a limited quantity of high grade. The two ores will be mixed for treatment, thus prolonging the life of both mines. A still further consolidation is to be effected between these two companies. In this district, also, the Barnes-King mine has undergone a change in ownership and administration in 1907, which constituted one of the most regrettable occurrences in the history of mining of Montana. The Barnes-King Development Company was formed and successfully floated, with heavy capitalization, upon the assertion that large ore reserves were available in the mine. When work was begun, it was found that but a small quantity of ore was in sight. It is still more regrettable that the persons responsible for such misrepresentation have not been found and properly punished. The Kendall and the Barnes-King mines have been easily the heaviest producers of Fergus County for the year 1907.

Warm Springs district.—This district covers a part of the Judith Mountains, near Lewistown. The Gold Reef mines were leased during 1907. The ore from the open cuts was taken through the 320-ton cyanide plant. Other producers for the year were the Liberty, the Ruby Gulch, and the War Eagle, all of which shipped to East Helena.

FLATHEAD COUNTY.

Libby district.—Of the $6,963 produced in Flathead County, $5,358 were from placer workings. Among the deep mines the Snowshoe is still inactive, but the Shaughnessy Hill shipped ore to Everett, Wash. The total production showed an increase of $255. The Cabinet district in this county shows no active mines.

GRANITE COUNTY.

Production of metals and their ores in Granite County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold .... fine ounces..	6,444.06	$133,211	3,335.51	$68,951	−3,108.55	−$64,260
Silver .... do....	319,700	214,199	456,096	301,023	+ 136,396	+ 86,824
Copper .... pounds..	63,626	12,280	44,311	8,862	− 19,315	− 3,418
Lead .... do....	294,517	16,786	71,237	3,776	− 223,280	− 13,010
Total value	....	376,476	....	382,612	....	+ 6,136
Ore output .... short tons..	14,959	[a] 25.12	16,652	[a] 22.33	+ 1,693	− [a]2.79

[a] Value per ton, placer product excluded.

Reports from the deep mines of Granite County show an increase from 14,959 tons in 1906 to 16,652 tons in 1907, and a corresponding increase in total values from $376,476 to $382,612. Although this margin of increase is less than 2 per cent, it is noteworthy in that it occurs altogether in silver. In the production of this metal Granite ranks third in the State; Silver bow and Jefferson counties stand first and second, respectively. The decrease in average value per ton of all ores is probably the result of the enlarged tonnage. Renewed activity in the placer fields raised their total annual returns from $642 to $10,676.

First Chance district.—The output of ores and recoveries of values from this gold-silver area compare very unfavorably with those of former years. From 3,250 tons, having a value of $108,255, in 1906 the output fell to 671 tons, having a value of $20,474, in 1907. The operating mines include the Cascade, the First Chance group, and the Shamrock. In the Cascade mine and the First Chance group, respectively, 800 feet and 300 feet of development work was accomplished in 1907. The ores from the latter are worked in a 10-ton stamp mill, with plate amalgamation and concentration.

Flint Creek district.—The twelve producing mines of the Flint Creek district at Philipsburg have made a very favorable showing in all metals except lead. The production of 7,849 tons of ore in 1906 was nearly doubled in 1907, and the total value of $237,669 recovered in the former period rose nearly 44 per cent in the latter. A marked rise in silver output occurred in this district—the district total was 306,896 fine ounces in 1906 and became 448,850 fine ounces in 1907. The gold and copper outputs were augmented to a less extent. The Good Hope, Granite Bimetallic, Trout, Jefferson, and Hobo mines were steady shippers to the lead smelters at East Helena. The Hope mine shaft was sunk 250 feet during the year 1907, and the

Jefferson tunnel lengthened 150 feet. At the Trout mine a 10-ton 1,000-foot gasoline hoist was installed, though comparatively little dead work was done. The Hobo group has some 2,000 feet of tunnels.

Production of metals and their ores in the Flint Creek district, Granite County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold....fine ounces..	1,011.54	$20,910	1,713.83	$35,428	+ 702.29	+$14,518
Silver....do....	306,896	205,619	448,850	296,241	+141,954	+ 90,622
Copper....pound..	7,197	1,389	38,311	7,662	+ 31,114	+ 6,273
Lead....do....	171,072	9,751	43,247	2,292	−127,825	− 7,459
Total value....	....	237,669	....	341,623	....	+103,954
Ore output....short tons..	7,849	[a]30.25	15,665	[a]21.81	+ 7,816	− [a]8.44

[a] Value per ton.

Gold Creek district.—Considerable placer mining in a small way was done along Gold Creek. No producing deep mines reported from that region. An electric power plant was projected for the Tussel and the Gold Creek placer mines jointly.

South Boulder district.—The Brooklyn, Gold Reef, Nonpareil, and Royal Gold reported from the South Boulder district, near Princeton. Much of the Gold Reef ore is free milling and is treated on the property in either a 35-ton free milling plant or a 10-ton cyanide mill. The Nonpareil is worked through a 300-foot shaft.

JEFFERSON COUNTY.

Production of metals and their ores in Jefferson County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold....fine ounces..	8,712.51	$180,104	15,525.09	$320,932	+6,812.58	+$140,828
Silver....do....	268,807	180,101	775,159	511,605	+ 506,352	+ 331,504
Copper....pounds..	255,428	49,298	238,822	47,764	− 16,606	− 1,534
Lead....do....	811,616	46,262	1,414,952	74,992	+ 603,336	+ 28,730
Total value....	....	455,765	....	955,293	....	+ 499,528
Ore output....short tons..	20,631	[a]21.89	41,829	[a]22.77	+ 21,198	+ [a]0.88

[a] Value per ton, placer product excluded.

Jefferson County ranks first in per cent of gain in value of metals produced in 1907. While the yield came from fewer mines by one-third than in 1906, and was detracted from by a loss in copper values, it was sufficiently great to raise the county from fourth to second in rank of total value of production. The 41,829 tons, valued at $955,293, represent a gain of nearly 103 per cent in tonnage and nearly 110 per cent in value of metals. Here may be noticed an increase in tonnage, accompanied by an increase in value per ton. In value of placer production, the county total of $4,089 for 1906 fell to $2,966 for 1907.

Boulder district.—The Baltimore mine at the town of Boulder is worked by a vertical shaft 140 feet deep and about 2,000 feet of levels. Its ore carries copper in fair quantity as well as gold, silver, and lead.

Cataract district.—In the vicinity of Basin, the Columbia, Apollo, and New Buckey mines were among those which treated no ore during 1907. The highest tonnage came from the Comet, owned by the Montana Consolidated Copper Company; the Ruby, by P. F. Dowling, and the Hattie Ferguson, by the Pennsylvania and Montana Mining Company. The yield from the Ruby mine was chiefly gold; with one exception the other mines exceed in silver. In this district the Comet and Grey Eagle mines have recently been purchased by the Montana Consolidated Copper Company. The Ruby was also bought by lease and bond during 1907 by P. F. Dowling. It has a 10-stamp mill with amalgamation and concentration. Nearly all the veins in the district are tapped by adit tunnels; the Comet shaft, an 800-foot vertical, and the Hattie Ferguson, a 100-foot vertical, are notable exceptions. Many of the mines contain much zinc, and it is reported that the old plant of the Basin Reduction Company will be refitted for experimental runs for the recovery of that metal. Among the mines at which development work was pushed were the Eva May, where the vertical shaft was sunk 600 feet, thus doubling its depth; and the Comet, where the shaft was deepened 600 feet.

Production of metals and their ores in the Cataract district, Jefferson County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold........fine ounces..	2,152.13	$44,489	5,090.26	$105,225	+2,938.13	+$60,736
Silver........do....	107,697	72,157	98,814	65,217	− 8,883	− 6,940
Copper........pounds..	35,721	6,893	10,457	2,091	− 25,264	− 4,802
Lead........do....	331,497	18,895	392,702	20,813	+ 61,305	+ 1,918
Total value........	....	142,434	....	193,346	....	+ 50,912
Ore output........short tons..	5,502	[a]25.89	3,312	[a]58.38	− 2,190	+ [a]32.49

[a] Value per ton.

Colorado district.—In the returns from the Colorado district, at Wicks, a slight improvement for the year is noticeable in the yield of silver and copper; the gold and lead returns, however, have diminished to the extent of lowering the total values $2,006 below those of 1906. The ores mined were 477 tons less than in 1906, but they increased in average value per ton from $25.15 to $30.37. The Bertha
mine shipped a silver-copper ore during 1907, and machinery
being installed at the mine in the latter part of tha
Alta mine is an intermittent producer. The reductio
property is little used. The Blue Bird mine shippe
East Helena and Washoe. None of these producers
shafts. The Atlas shaft was sunk 150 feet deeper, t
nel lengthened 600 feet, and the Blue Bird tunnel 2
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Production of metals and their ores in the Colorado district, Jefferson County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold ....fine ounces..	303.86	$6,281	195.96	$4,051	−107.90	−$2,230
Silver..........................do.....	23,066	15,453	25,029	16,519	+ 1,963	+ 1,066
Copper ....pounds..	168,374	32,496	167,496	33,499	− 878	+ 1,003
Lead ....do.....	104,572	5,962	77,688	4,117	−26,884	− 1,845
Total value	....	60,192	....	58,196	....	− 2,006
Ore output.............short tons..	2,393	*a* 25.15	1,916	*a* 30.37	− 477	+ *a* 5.22

a Value per ton.

Elkhorn district.—It is in the Elkhorn camp that the decided rise in values for Jefferson County occur. The total number of ounces of silver for 1907 was 529,362, as against 39,788 in 1906, and the quantity of lead recovered in 1907 was 623,346 pounds, as against 68,313 pounds for 1906. The gold values dropped noticeably, and no copper was reported. At the Golden Curry mine a 100-ton cyanide plant was in course of construction in 1907. The ore shows by assays an excess of iron and yields gold, and it has been shipped to the East Helena smelters. The Rose Gold Mining and Milling Company also shipped gold-silver ore to these smelters. The Elkhorn mine, of the Elkhorn Silver Mining Company, was completely unwatered during 1907. The gold-silver ore from this mine goes through a 110-ton concentrator, and thence with the crude lead-silver ore to the lead smelters at East Helena. Other producing mines were the Center Reef, Golden Moss, Peacock, and Keene. In the way of development the Elkhorn added 400 feet of levels, and the Golden Curry 270 feet of tunnels in 1907.

Production of metals and their ores in the Elkhorn district, Jefferson County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.................fine ounces..	3,950.22	$81,657	3,433.13	$70,969	− 517.09	−$10,688
Silver ....do.....	39,788	26,659	529,362	349,379	+489,574	+322,720
Copper ....pounds..	27,158	5,242	....	....	− 27,158	− 5,242
Lead ....do.....	68,313	3,895	623,346	33,037	+555,033	+ 29,142
Total value	....	117,453	....	453,385	....	+335,932
Ore output.............short tons..	8,964	*a* 13.10	29,553	*a* 15.34	+ 20,589	+ *a* 2.24

a Value per ton.

Gulch district.—Both the Little Nell and the Liverpool
ipped silver-lead ores from Clancey, in this district, in 1907.
le Nell property is developed by a 500-foot vertical shaft, 400
ing been sunk during the year just mentioned. The Liver-
well developed, but not worked steadily.

Spring district.—The Bell, Carbonate Chief, and Mocking
ines operated extensively in the Warm Spring district, near

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Clancey. The 41,829 tons of ore mined produced a gross value of $952,327, mainly in gold and silver, though copper and lead were recovered. In 1906 the yield was 1,237 tons, with a metallic value of $47,756. It will be observed that the value for 1907 was increased nearly twentyfold. In the Bell mine the tunnel was extended 360 feet; in the Carbonate Chief the tunnel was driven 200 feet; and in the Mocking Bird, a new producer, the vertical shaft was sunk 250 feet.

LEWIS AND CLARK COUNTY.

Production of metals and their ores in Lewis and Clark County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold ..... fine ounces..	529.92	$10,954	1,237.72	$25,586	+ 707.80	+$14,632
Silver ..... do....	86	58	438	289	+ 352	+ 231
DEEP MINES.						
Gold ..... fine ounces..	25,327.03	523,556	24,986.80	516,523	− 340.23	− 7,033
Silver ..... do....	102,603	68,744	165,038	108,925	+ 62,435	+ 40,181
Copper ..... pounds..	47,537	9,173	27,367	5,473	− 20,170	− 3,700
Lead ..... do....	522,248	29,768	1,000,337	53,018	+478,089	+ 23,250
Total value	.....	642,253	.....	709,814	.....	+ 67,561
Ore output ..... short tons..	96,437	[a] 6.55	95,277	[a] 7.18	− 1,160	+ [a] 0.63

[a] Value per ton, placer product excluded.

The number of operating deep mines of Lewis and Clark County was fewer in 1906 than in 1907. While the yield in ore dropped from 96,437 tons in 1906 to 95,277 tons in 1907, the average value increased to such an extent that the total value of metals produced rose from $642,253 to $709,814. This was to be principally credited to silver-lead ores. The placer production of $25,875 in 1907 compares favorably with that of $11,012 for 1906. In Lewis and Clark County 33,966 tons of old tailings were treated; in this respect the county stands second only to Silverbow, whose 45,182 tons are chiefly smelter cleanings.

Bald Butte district.—The Bald Butte, Mammoth, and Strawberry mines operated in this region. In the Bald Butte there are 33,000 feet of workings; 400 feet were added in 1907. Part of the ore is amalgamated at the 40-stamp mill and the remainder is shipped as concentrates to lead smelters.

Ottawa district.—The Ottawa district, at Marysville, was the most productive region of Lewis and Clark County in 1907. The Drum-Lummon mine, of the Montana Mining Company (Limited) worked gold-silver ore throughout the year. The ore is crushed in the 40-stamp mill and the values recovered either on the plates or from the precipitates of the 400-ton cyanide plant. The North Star mine also milled a gold-silver ore. During the year the shaft on this property was sunk 200 feet deeper. The table following compares the returns from this district for the two years indicated.

Production of metals and their ore in the Ottawa district, Lewis and Clark County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..................fine ounces..	3,048.25	$63,013	3,381.46	$69,901	+ 333.21	+$6,888
Silver..................... do......	30,717	20,579	53,341	35,205	+ 22,624	+14,626
Copper ....pounds..	10,008	1,932	19,240	3,848	+ 9.232	+ 1,916
Lead........................ do....	9,064	517	41,695	2,210	+ 32,631	+ 1,693
Total value	....	86,041	....	111,164	....	+25,123
Ore output............short tons..	22,456	[a] 3.83	34,999	[a] 3.18	+12,543	− [a] .65

[a] Value per ton.

Poorman district.—Recoveries were made from the dump of the Gloster mine. The Cannon Brothers worked the Twentieth Century mine at Lincoln. The ore is hoisted 100 feet by incline shaft and treated in a 5-stamp amalgamation mill without concentration.

Spring Hill district.—In 1907 this district yielded a total of 11,179 tons of ore, which gave a gross value of $56,283. In 1906 the tonnage was 22,465 and the value $65,286. These data indicate a marked improvement in ore values. The returns are almost exclusively in gold and silver. The Howard and Helena mines, however, shipped gold-silver-lead ores to the East Helena smelters. In 1907 the Spring Hill mine installed a 70-ton cyanide plant, with which to treat the tailings from the old stamp mill as well as the ore from the mine. The property is developed by an adit tunnel of 850 feet, with 1,000 feet of other levels, 400 feet of which were added in 1907. The Helena mine was also developed further by deepening the shaft 200 feet. Among the placer properties the Eglanol, at Lincoln, extended a drift of 600 feet into the gravel. The Spring Hill district is often called the Helena district. Last Chance Gulch, once a famous placer ground, is now a part of the business district of Helena.

Stemple district.—The Gould Mines Company operated a 30-stamp amalgamation mill without concentration. The company owns also a 100-ton cyanide plant. Mining is conducted by means of a 600-foot vertical shaft and 6 levels, in all about 3,500 feet. The Empire mine of the Gold Cord Mining Company reported no production for 1907. This company's equipment includes a 60-stamp mill and a 500-ton cyanide plant.

Unionville district.—In the latter part of 1907 the Whitlatch mine was under lease and bond to the Spring Hill Mining Company. The concentrates from the 20-stamp mill are shipped to the East Helena smelters, while the bullion from the plates goes to the United States assay office at Helena. The Whitlatch shaft has been deepened to 500 feet.

Vaughn district.—The lead mines of the Vaughn district, at Rimini, produced 5,595 tons and yielded a value of $173,648 in gold, silver, and lead. The Valley Forge mine is worked through tunnels aggregating more than 2,200 feet in length. The mine shipped regularly to East Helena during the year 1907. Other shipments are reported from the Matt Carrol and Bassett mines.

MADISON COUNTY.

Production of metals and their ores in Madison County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold ....fine ounces..	18,916.74	$391,044	9,462.59	$195,699	−9,454.15	−$195,435
Silver ....do....	3,020	2,023	1,569	1,035	− 1,451	− 988
DEEP MINES.						
Gold................fine ounces..	13,142.24	271,674	8,953.05	185,076	−4,189.19	− 86,598
Silver......................do....	114,456	76,685	72,263	47,694	− 42,193	− 28,991
Copper ....pounds..	80,633	15,562	33,854	6,771	− 46,779	− 8,791
Lead ....do....	461,986	26,333	90,037	4,772	− 371,949	− 21,561
Total value................................		783,321	....	440,957	....	− 342,364
Ore output............short tons..	20,497	[a] 19.04	11,818	[a] 20.67	− 8,679	+ [a] 1.63

[a] Value per ton, placer product excluded.

Conditions for normal production of metals in Madison County in 1907 were unfavorable. Few of the mines have shipping contracts with smelters, so that when the smelters declined to take custom ores in the fall of the year many mines were forced to suspend. It seems, moreover, that not enough gold mills were kept in operation to make a fair showing in values from the siliceous ores. From 60 deep mines in 1906 the number fell to 50 in 1907; there was a decrease from 20,497 tons in 1906 to 11,818 tons in 1907; and the values for the two periods, respectively, were $390,254 and $244,313. Thus the number of tons decreased 8,679 and their gross yield $145,941. The only increase in any direction was in average value per ton, which was $19.04 in 1906 and $20.67 in 1907.

In placer production also there seems to be more development than results. In the rank of placer producers, however, this county still leads. In 1907 the total value of its placer gold and silver was $196,644, or 56 per cent of $350,586, the total placer value for Montana. Two electric dredges were in course of construction by the Conrey Placer Mining Company on the flats of lower Alder Gulch and 2 others were projected by this company. It is estimated that there is enough virgin ground on the claims of this company to occupy 5 dredges for fifteen years. The dredges recently built are of the Marion type, having a closely connected bucket chain and 10-ton buckets. The old dredge of the company is of the open-chain type, with 14-ton buckets. The gravel bed is from 30 feet to 56 feet deep, with the best values about 6 feet above the soft, plastic bed rock. In the upper portion of the gulch the Alder Gulch Mining Company operates by means of a ground sluice and flumes. An average of all estimates gives $125,000,000 as the values washed out of Alder Gulch since its first claims were staked. This places it in first rank among the placer gulches of the world. At one time 5 organized districts were maintained within 10 miles of its length.

Browns Gulch district.—The Easton and Pacific group is the chief operator in Browns Gulch. During 1907 a power dam was in course of construction near these mines. The project is intended not only to furnish power for mining purposes, but also for electric facilities for Virginia City, 12 miles away. Concentrates from the Easton mine were shipped to East Helena.

Fairweather district.—The Alameda, Elfleda, and Prospect mines were the chief operators. Besides the precious metals the Alameda ores yield a small quantity of lead.

Lower Hot Springs district.—Shipments were made from the Boaz, the Red Bluff, and the Thorn Fraction; the last is a new mine. Considerable development work was also done on the Hecla mine.

Mineral Hill district.—The Garnet Gold Mining Company milled and shipped steadily. Its crude ore and concentrates yield values in copper; zinc is also present in the ore. The company did 300 feet of development work, which makes a total of 1,000 feet of shaft and 5,000 feet of levels. Ore was shipped to East Helena from the Oregon mine and from the Boss Tweed. New claims reported are known as the Bozeman group. The Pony, Proctor Knot, and Tesla mines were operated a few weeks of the year. The comparative tabulation below shows that the average value per ton was increased materially.

Production of metals and their ores in the Mineral Hill district, Madison County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..................fine ounces..	4,008.37	$82,859	2,541.82	$52,544	−1,466.55	−$30,315
Silver ....do....	8,893	5,959	4,325	2,854	− 4,568	− 3,105
Copper ....pounds..	50,383	9,724	28,590	5,718	− 21,793	− 4,006
Lead ....do....	112,007	6,385	7,500	397	− 104.507	− 5,988
Total value	....	104,927	....	61,513	....	− 43,414
Ore output............short tons..	11,132	[a]9.42	4,924	[a]12.49	− 6,208	+ [a] 3.07

[a] Value per ton.

Rabbit district.—At the Legal Tender ore was hoisted through the 115-foot incline shaft, and from the Eureka and the Clifton a few cars of ore were shipped. Development work was done at the Watseca.

Silver Star district.—For the Silver Star district the progress in production of gold is shown in the table below. The Broadway mines yielded several shipments of gold-silver-copper-lead ore. The mine is extensively developed by 950 feet of shafts and 1,100 feet of tunnels. The Greene-Campbell mine milled for part of the year. The company owns a 100-ton concentrator and a 25-ton Huntington mill, with plate amalgamation. Shortage of water prevented continuous running. The Hudson and Iron Rod group are worked by 2 incline shafts 360 feet deep. The 15-stamp mill on the property was not in use in 1907, but the ore was treated at East Helena.

Production of metals and their ores in the Silver Star district, Madison County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..................fine ounces..	1,668.11	$34,482	2,115.97	$43,741	+ 447.86	+$9,259
Silver ....do....	2,847	1,909	2,319	1,531	− 528	− 378
Copper ....pounds..	22,733	4,387	4,237	848	− 18,496	− 3,539
Lead ....do....	123,925	7,063	9,691	513	−114,234	− 6,550
Total value	....	47,841	....	46,633	....	− 1,208
Ore output............short tons..	1,919	[a]24.93	2,307	[a]20.21	+ 388	− [a] 4.72

[a] Value per ton.

Summit district.—The Kearsarge shaft was deepened 300 feet. Ore from the St. John mine was shipped to the Butte Reduction Works and to East Helena, and a few tons of gold-silver ore from the Oro Cache mine were also shipped to the latter plant.

Tidal Wave district.—A few mines in this district produced 184 tons of ore, which yielded gold, silver, and rather good values in lead.

Upper Hot Springs district.—The Revenue mine was worked by lease. The 75-ton cyanide mill with Cornish rolls, built mainly to work tailings was not in operation. Silicious ore from the Columbia and George Washington mines was shipped to East Helena.

Washington district.—The George McKee mine employs a 5-stamp amalgamation mill and a concentrator. Its concentrates are sent to the Washoe smelters. The Lehigh and Hornet mines were active in 1907. The reports show a fair yield for the year.

Whitehall district.—The 5 producing mines of the Whitehall district reported gross returns of $14,620, an increase of $487 over the values of 1906. The tonnage, however, was much greater in 1907, amounting to 2,175 tons as against 368 tons in 1906. The Colorado, Daisy Bell, Gold Hill, Mary Ingabar, and Mammoth mines reported production. At the Mammoth a 100-ton roller concentrating mill has been installed recently, and 400 feet of tunneling driven. The Gold Hill ore yields low values in lead besides precious metals.

MEAGHER COUNTY.

Silver-copper ore was shipped from Delpine in the Spring Creek district to smelters at Butte. A small placer yield came from Thompson Gulch. The total gross production for the county was $1,752 in 1906 and $9,186 in 1907.

MISSOULA COUNTY.

Production of metals and their ores in Missoula County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold .... fine ounces..	2,256.23	$46,640	2,010.85	$41,568	−245.38	−$5,072
Silver .... do....	85	57	89	59	+ 4	+ 2
DEEP MINES.						
Gold .... fine ounces..	80.16	1,657	17.27	357	− 62.89	− 1,300
Silver .... do....	2,510	1,682	6,027	3,978	+ 3,517	+ 2,296
Copper .... pounds..	57,436	11,085	86,200	17,240	+28,764	+ 6,155
Lead .... do....	....	....	9,000	477	+ 9,000	+ 477
Total value	....	61,121	....	63,679	....	+ 2,558
Ore output .... short tons..	409	[a]35.26	609	[a]36.21	+ 200	+ [a].95

[a] Value per ton, placer product excluded.

Missoula County tabulations showed an increase in all respects except in the production of gold. In this connection it may be remarked, however, that the placer gold from this county is commonly more than 950 fine, which is the highest average fineness in the State.

The number of tons of ore treated in 1906 was 409, and the total values reached $14,424; for 1907 the tonnage was 609 with a gross value of $22,052. The value per ton was thus increased from average $35.26 in 1906 to $36.21 in 1907.

St. Regis district.—The Denver and Rock Island Development Company reports a new mine from near De Borgia. The Iron Mountain Tunnel Company finished the last 1,000 feet of its 4,000-foot drainage tunnel, and will doubtless enter as a strong producer in 1908.

Wallace district.—The greater part of the production from Missoula County comes from the chalcopyrite copper ores of the Wallace district, near Clinton. The Cape Nome Copper Company shipped to Tacoma, Wash., and to East Helena and Anaconda, Mont. The company also did 250 feet of development work. The Hidden Treasure mine now has 2,600 feet of tunnels. The mine was worked in part by lessees. The Amador smelter and electric tramway was sold to the Lacasse Brothers of Missoula. The Triangle Mining Company shipped several cars of copper ore and drove a 300-foot tunnel.

PARK COUNTY.

The mining industry in Park County was more active in 1907 than in 1906. In 1907 the number of tons treated was 1,700, and the value won $31,890. In 1906 the quantity was 218 tons, and the value $7,316. No production was reported from the Crevasse district, but progress is recorded from the New World and Sheepeater districts. In the former district the Hudson and Boulder group is worked by 900 feet of tunnels on a limestone-igneous contact. In the Kimberley mine in the Sheepeater district, at Jardine, free gold in quartz and schist is found in the oxidized zone, and gold in arsenopyrite in quartz veins in slate in the sulphide zone. Several hundred tons of scheelite, or calcium tungstate, were shipped in 1907. In places the veins are definite, but in others they are so irregular and bunchy as to be masses rather than veins. The total length of the 17 tunnels in this mine aggregates more than 5 miles. The equipment consists of a 40-stamp plate-amalgamation mill and a 100-ton cyanide plant, with a Huntington mill for the preparation of scheelite concentrates. In the Independence mine 800 feet of tunnels were driven and 300 feet in the Republic. Neither of these reported production.

POWELL COUNTY.

Production of metals and their ores in Powell County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold....fine ounces..	2,123.68	$43,900	1,181.61	$24,426	− 942.07	−$19,474
Silver....do....	260	174	160	106	− 100	− 68
DEEP MINES.						
Gold....fine ounces..	2,402.06	49,655	3,807.93	78,717	+1,405.87	+ 29,062
Silver....do....	29,174	19,547	20,255	13,368	− 8,919	− 6,179
Copper....pounds..	7,555	1,458	1,397	279	− 6,158	− 1,179
Lead....do....	180,289	10,277	164,911	8,740	− 15,378	− 1,537
Total value....	....	125,011	....	125,636	....	+ 625
Ore output....short tons..	9,127	[a] 8.86	3,951	[a] 25.59	− 5,176	+ [a] 16.73

[a] Value per ton, placer product excluded.

In Powell County there were 3,951 tons of ore treated in 1907, a decrease of 5,176 tons as compared with the 9,127 tons treated in 1906. The total values, $101,104 for 1907 and $80,937 for 1906 from deep mines, taken with their respective totals of tonnage, show the remarkable rise in average value per ton from $8.86 in 1906 to $25.59 in 1907. This advance is due to the high-grade ores encountered in a single mine in this county. The number of deep mines reporting production was 10 in 1907, against 8 in 1906. Some of the mines in this county yield fair assays of zinc.

Elliston district.—The Evening Star mine (formerly called the Big Dick mine) has been sold to the Butte and Elliston Mining Company. This mine has a 300-foot shaft and 800 feet of levels. It shipped highly siliceous ore carrying gold, silver, and lead both to the East Helena and the Washoe smelters. The Fairview, Nattie, and Silver Star mines are included among the producers in the Elliston district,

Washington Gulch district.—The average value per ton in this district is much enhanced by a reported high value of gold ore. The Elkhorn ore is extracted through a tunnel 300 feet long; the Gold Seal ore is hoisted through a vertical shaft 80 feet in depth. The Mammoth mine near Coloma is developed by 600 feet of tunnels.

Zozell district.—The Deerlodge Consolidated Mining Company has built a new mill at the Emery mine. The mine is worked through a shaft of 900 feet on the incline of the vein and thence 475 feet vertically. Shipments of crude ore and concentrates went to East Helena and brought returns in gold, silver, and lead. The Deerlodge Queen mine was also in operation.

RAVALLI COUNTY.

The Providence mine in the Eight Mile district, near Florence, was operated during the year. The ore was mined by means of a 100-foot incline shaft, and was shipped to the East Helena smelters. The Curlew mine did 200 feet of development work in its shaft. The Ore Finder and Black Hawk mines reported development work.

SILVERBOW COUNTY.

Production of metals and their ores in Silverbow County, Mont., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.........fine ounces..	60,495.97	$1,250,563	34,367.59	710,441	− 26,128.38	− $540,122
Silver...............do....	10,715,721	7,179,533	7,516,659	4,960,995	− 3,199,062	− 2,218,538
Copper ....pounds..	289,780,050	55,927,550	218,836,627	43,767,325	−70,943,423	−12,160,225
Lead ....do....	895,566	51,048	223,676	11,855	− 671,890	− 39,193
Zinc................do....	6,579,000	401,319	243,100	14,343	− 6,335,900	− 386,976
Total value	....	64,810,013	....	49,464,959	....	−15,345,054
Ore output....short tons..	5,019,234	[a]12.91	3,735,346	[a]13.23	− 1,283,888	+ [a]0.32

[a] Value per ton, placer product excluded.

The census of the mining industry of Silverbow County in 1907 shows that from the 80 deep mines of the county 3,735,346 tons of ore yielded a value of $49,464,959. From the deep mines in 1906 5,019,234 tons were treated, yielding a total value of $64,810,013. The decrease in tonnage is 1,283,888, and in values $15,345,054. These data indicate that in the year 1907 the tonnage decreased to a little more than 74.4 per cent and the values to a little less than 76.3 per cent of the respective totals for 1906. When the price of copper fell below the limit for good profits from low-grade ores, the large producers began smelting those of higher grade. This is true in even a greater degree at the last of the year, when the Washoe smelters were closed and the ores from the few mines then operating went to the Boston and Montana smelters. The effect is evident in the rise in average value per ton from $12.91 to $13.23, or 32 cents per ton.

There was a small production from deep mines in the Divide Creek district in the southern area of Silverbow County, and a small yield from Rochester Basin in the same region. Still another placer ground known as German Gulch, in the northwestern part of the county, was worked in 1907. Aside from these small productions the values from Silverbow County were from the Summit Valley district.

Another field of prospecting lies 25 miles south of Butte, in the Highland Mountains. One company has ordered machinery and other equipments for a mine in this region some 5 miles from the nearest station on the Milwaukee and St. Paul Railway. Development was also pursued in the region of the Continental Divide 12 miles northeast of Butte.

Summit Valley district.—An incident of moment in the mining industry of the year was the adjustment with the Butte Miners' Union of a sliding scale of wages. The contract is to the effect that miners are to receive $4 per day when copper is selling at or above 18 cents per pound, and $3.50 when the price is lower. The agreement was reached March 26, 1907, but did not take effect until November 1, 1907, from which time it will obtain for five years. During the year a strike of the machinists was satisfactorily settled, as well as a similar difficulty of short duration with the teamsters.

On account of the low price of copper and the large surplus of the metal on hand, the Amalgamated Copper Company issued an order about the middle of September restricting production from its mines to nearly 60 per cent of normal production. On December 7 another order was issued closing the Washoe smelters at Anaconda. Production then ceased from the mines of 5 of the subsidiary companies as well as from those of the North Butte and Red Metal companies, affiliated with the Amalgamated. A stronger working force, however, was put into the mines of the Boston and Montana Company, which treats its ores at its own smelters and refinery at Great Falls. During the crisis this company shipped about 3,700 tons of ore per day. Excepting these mines and those of the original company, all copper mines in the district were affected by the closing of the Washoe smelters. The mines of the latter company were worked as usual and the ores were treated at the Butte Reduction Works. This plant smelted also some shipments from the North Butte Company. During 1907 very marked improvements were under way at the Butte Reduction Works. A 700-ton concentrator was built, in which 10 improved Hartz jigs are made to do the work of 50 Hartz jigs of the older type. The whole capacity of the concentrator is now 1,200 tons in 24 hours, or about equal to that of the smelters. Twelve hundred feet of 8 by 16 foot reinforced concrete culvert was built to preserve the channel of Silverbow Creek through the works. The storage bins for concentrates were also reconstructed of concrete. New plans are used for storing Wyoming coals in the bins, replacing those destroyed several months ago by spontaneous combustion. The Washoe smelters remained closed until after the first of the year, during which time parts were strengthened to such an extent that the capacity of output has been increased to approximately 11,000 tons per day. At the Boston and Montana smelters the foundation for the new stack was laid and an elaborate system of flues constructed. The height of the stack above the ground on which it stands will be 506 feet; however, the elevation of the stack site is such that the top will be 742 feet above the charging floor of the blast furnaces. Plans were made for increasing the capacity of these smelters to approximately 8,000 tons per day.

About November 1 the Pittsburg and Montana Company blew in their smelter again and set to work about 150 men. This company supplanted the Baggaley form of pyritic smelting by the usual methods of treatment for the copper ores of Butte, and added 4 new blast furnaces. They also installed a 25-drill compressor for power on the lower levels, and later began erecting a 150-ton concentrator.

During a brief time, in which the lead smelters of the American Smelting and Refining Company at East Helena did not receive ore, some of the silver-lead ores from the Summit Valley district were sent to smelters in Utah, so that the industry of these mines was not materially hindered.

Several companies in the district have to report only development work for the year. Among these are the Davis-Daly, Butte and London, Butte Copper Exploration, Raven, Montana Consolidated, Alliance, and Colusa Leonard Extension companies. The Original company did 1,600 feet of crosscutting for the Davis-Daly company. After sinking to the 1,000-foot level the Butte and London Company has temporarily abandoned work.

On its own property the Original company sank through barren ground into a 60-foot vein of ore. This company also pushed development work on the Elm Orlu and Poser claims, which have already begun producing. A large tunnel was finished connecting the Rarus and Tramway mines. The ores from the Rarus mine will be trammed through this tunnel to the shaft of the Tramway, thus saving 210 feet of grade for the locomotives in reaching the ore bins of the Rarus. New 32 by 72 hoists, for maximum depths of 3,500 feet, have been added to the equipment of both the Tramway and the Pennsylvania mines, and four 600-horsepower compressors to that of the Leonard. An 85-foot sump was excavated below the 2,700-foot level in the Anaconda shaft. From this mine is pumped the drainage of those closely surrounding it. The discovery of the large ore body on the 2,400-foot level of the Anaconda in 1906, and the striking of what was considered as its continuation on the same level of the Never Sweat in 1907, together with similar bonanzas found in the Rarus and Minnie Healy mines in 1907, go to show that the decrease in production can not be attributed to a lack of ore in sight. Although it has been argued that, on account of the increasing depth and temperature of the copper mines of Butte and the consequent difficulty of working them, the record production of 1905 will never be reached again, it is probable that a continued active demand for copper would accomplish such a result. The improvements mentioned above in both mines and smelters would also indicate a tendency toward enlarged production when conditions shall warrant.

NEVADA.

By Charles G. Yale.

PRODUCTION.

For 1907, in Nevada, $17,591,486 represents the total value of the production of gold, silver, copper, lead, and zinc, taken from 216 deep mines and 13 surface mines. The yield of gold alone was 585,311.14 fine ounces, valued at $12,099,455, and the value of silver at the average commercial price for the year was $4,675,178. The combined value of gold and silver was $16,774,633, an increase over that of 1906 of $1,767,619. Less than $1,000,000 of the state total came from the combined value of copper, lead, and zinc. There was an increase in all kinds of ore mined. The total increase in tonnage was 227,274 short tons. Of a total of 723,581 tons, 628,501 tons were siliceous ore, of which Nye County produced 241,677 tons, 214,357 tons being from Tonopah. The largest tonnage of siliceous ore from one mine was that of the Tonopah Mining Company of Nevada, at Tonopah, Nye County. The average value per ton of siliceous ore in gold and silver was $25; of copper ores, $6.65; of lead ores, $9.86; of copper-lead ores, $16.87; of copper-lead-zinc ores, $25.81; and the average value per ton of all kinds of ore was $23.10. During 1907 there were treated at gold and silver mills 436,779 tons of ore, from which were saved $2,785,634 in gold, or an average per ton of $6.38, and $1,400,039 in silver, or an average per ton of $3.20, a total value in gold and silver of $4,185,673, and an average per ton of $9.58.

From the 436,779 tons treated at gold and silver mills and from 16,569 tons of copper, lead, and zinc ores sent to concentrating mills, a total to both classes of mills of 453,348 tons, were produced 11,702 tons of concentrates, valued at $445,642 in gold, or an average per ton of $38.08, and $739,226 in silver, or an average per ton of $63.17, a total in gold and silver of $1,184,868, and an average of $101.25 per ton.

Crude ore shipped to smelter amounted to 199,033 tons, containing $8,812,904 in gold, averaging $44.28 per ton; $2,534,695 in silver, averaging $12.74 per ton; a total of $11,347,599, and an average per ton of $57.02 in gold and silver. There were 71,200 tons of old tailings retreated, the values of which could not be separated from the mill bullion, and are included with it.

The statement of production for 1906 and 1907, showing increase and decrease, and value at the commercial price for each year, is as follows:

Production of gold, silver, and associated metals in Nevada in 1906 and 1907.

	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.	*Dollars.*	*Fine ounces.*	*Dollars.*	*Pounds.*	*Dollars.*
1906	506,520.31	10,470,704	6,770,611	4,536,310	1,625,985	313,816
1907	585,311.14	12,099,455	7,083,603	4,675,178	1,782,571	356,514
Increase (+) or decrease (−).	+78,790.83	+1,628,751	+312,992	+138,868	+156,586	+42,698

	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Dollars.*
1906	3,823,617	217,945	2,886,328	176,066	15,714,841
1907	6,271,341	332,381	2,168,783	127,958	17,591,486
Increase (+) or decrease (−).	+2,447,724	+114,436	−717,545	−48,108	+1,876,645

The production of ore in Nevada in 1907 was 723,581 short tons, having an average value per ton in gold and silver of $23.10, an increase over 1906 of 227,274 short tons in quantity and a decrease in value per ton of $6.91.

GOLD.

The total gold production for Nevada in 1907 was 585,311.14 fine ounces, valued at $12,099,455, as against 506,520.31 fine ounces, valued at $10,470,704, in 1906, an increase of 78,790.83 fine ounces, valued at $1,628,751. Goldfield district, Esmeralda County, alone produced $8,408,396 in gold, or almost 70 per cent of the gold output, and Tonopah, Nye County, produced $1,183,628, a total for the two districts of $9,592,024, which is over 79 per cent of the total gold output. Esmeralda County produced $8,533,617 and Nye County $1,547,408, a total of $10,081,025; Lincoln County ranked third with $929,775, and Storey County produced a little over $250,000 from the Comstock mines. Eureka, Churchill, and Elko counties, in order of their yield, all produced under $200,000. The largest source of gold was siliceous ore, the yield from that class of ore being $11,440,436, and mainly from Esmeralda, Nye, Lincoln, and Storey counties; over $500,000 came from the lead and copper-lead ores of Eureka and Lincoln counties.

The production from different kinds of ore, with increases as compared with 1906, is shown in the following table:

Source of gold product in Nevada in 1907 by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.							Grand total.
		Siliceous ore.	Copper ores.	Lead ores.	Copper-lead ores.	Lead-zinc ores.	Copper-lead-zinc ores.	Total.	
Churchill		7,371.38						7,371.38	7,371.38
Douglas	25.16	5.85	7.40					13.25	38.41
Elko		6,825.57	3.44	3.48		214.30		7,046.79	7,046.79
Esmeralda		412,773.09	30.47	10.16				412,813.72	412,813.72
Eureka		66.57		8,294.37	11.42		52.00	8,424.36	8,424.36
Humboldt		2,946.42	12.92	1.98	2.08		19.60	2,983.00	2,983.00
Lander		3,140.26	898.90	170.72	1.50			4,211.38	4,211.38
Lincoln		26,181.03	11.32	70.05	18,715.47			44,977.87	44,977.87
Lyon	23.27	3,675.48	1.11	13.50				3,690.09	3,713.36
Nye	2,395.53	72,224.41		228.28	7.64			72,460.33	74,855.86
Storey		11,918.68			401.95			12,320.63	12,320.63
Washoe		3,678.33				12.63		3,690.96	3,690.96
White Pine	229.97	2,624.01		4.64	4.79			2,633.44	2,863.41
Total	2,673.93	553,431.08	965.56	8,797.18	19,144.85	226.93	71.60	582,637.21	585,311.14
Increase	117.87	52,754.75	837.84	5,637.17	19,144.85	226.74	71.60	78,672.96	78,790.83

SILVER.

The silver yield in 1907 amounted to 7,083,603 fine ounces, valued at $4,675,178, as compared with 6,770,611 fine ounces, valued at $4,536,310 in 1906, an increase in 1907 of 312,992 fine ounces, valued at $138,862, at the commercial price for the year. Nye County produced $3,667,973 of the total value of the silver yield of which Tonopah yielded $3,544,788. The combined silver mines at Fairview, Wonder, and Stillwater, in Churchill County, produced silver valued at $432,617, and the lead-silver ores of Eureka County, and the Comstock ores of Storey County each yielded about $100,000 in silver. Siliceous ores yielded silver, valued at $4,275,166, and the bulk of the remainder, or $400,000, came from lead and lead-copper ores. The source of silver product, by kinds of ore, with increase and decrease, is shown in the following table:

Source of silver product in Nevada in 1907 by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.				
		Siliceous ore.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead ores.
Churchill		655,480				
Douglas	206		286			
Elko		7,294	1,820	986		
Esmeralda		89,576	1,523	5,974		
Eureka		6,833		148,774		95,017
Humboldt		10,521	2,341	2,058		1,439
Lander		2,991	66,586	69,043		4,915
Lincoln		27,392	9,022	7,185	7,668	5,099
Lyon	12	13,136	34	89		
Nye	1,585	5,482,697		35,494		37,759
Storey		160,674				2,117
Washoe		4,449				
Whitepine	43	16,481		12,607		25,467
Total	1,846	6,477,524	81,612	282,210	7,668	171,813
Increase	550	25,342	40,339	6,741	7,668	171,813

Source of silver product in Nevada in 1907 by kinds of ore, by counties, in fine ounces—Continued.

County.	Deep mines.				Grand total.
	Copper-zinc ores.	Lead-zinc ores.	Copper-lead-zinc ores.	Total.	
Churchill				655,480	655,480
Douglas				286	492
Elko		16,925	7,439	34,464	34,464
Esmeralda			4,716	101,789	101,789
Eureka			2,265	252,889	252,889
Humboldt			15,129	31,488	31,488
Lander				143,535	143,535
Lincoln	6		1,887	58,259	58,259
Lyon				13,259	13,271
Nye				5,555,950	5,557,535
Storey				162,791	162,791
Washoe		11,483		15,932	15,932
Whitepine			1,080	55,635	55,678
Total	6	28,408	32,516	7,081,757	7,083,603
Increase	6	28,017	32,516	312,442	312,992

COPPER.

The production of copper shows a slight increase for 1907. The production of 1906 was 1,625,985 pounds, valued at $313,816, and the yield for 1907 was 1,782,571, valued at $356,514, an increase of 156,586 pounds in quantity and $42,698 in value. Every county but Churchill produced copper during 1907, and all showed an increase over 1906, except Esmeralda, which fell off slightly. Lander County was first with 615,544 pounds, from Austin, Lander, Tenabo, and Galena (or Copper Basin) districts. Lyon County was second. Lincoln County was a close third, with the production from Pioche, Yellowpine district, and Searchlight. Elko County, which produced no copper in 1906, was credited with 164,492 pounds from the Bullion (or Railroad) district and Spruce Mountain. Eureka County had 2 copper-producing districts, Palisade and Eureka, which together produced 144,825 pounds. Whitepine increased its copper output slightly from Cherry Creek, Ely, Hamilton, and Newark. In view of the extensive operations around and near Ely district and the completion of the Steptoe smelter, Whitepine County should be the banner copper-producing county in 1908.

The Cumberland Ely Company plans to produce 1,000 tons of ore per day and the Nevada Consolidated, 3,000 tons, from the Ruth and Eureka mines. The Eureka mine of the Nevada Consolidated is to be worked by the open-cut, steam-shovel method, at an estimated cost of 45 cents per ton. The Ruth mine is to be worked by the caving system, at a cost of 90 cents per ton. The Giroux Consolidated Company expects to have its mill in full running order by October, 1908; and the Nevada Consolidated and the Cumberland-Ely companies will begin milling before the close of 1908. The annual productive capacity of Ely, it is estimated, will exceed 60,000,000 pounds. Siliceous ore from Tonopah is to be used for the lining of the converters at the smelter, and in case a direct line is built between Ely and Tonopah and Goldfield Ely may become a great customs center.

LEAD.

Nevada showed an increase in lead production of 2,447,724 pounds, valued at $114,436. The production of 1907 was 6,271,341 pounds, valued at $332,381, as compared with 3,823,617 pounds, valued at $217,945, in 1906. Eureka County showed an increase of almost 2,000,000 pounds, mainly from Eureka, and Whitepine County an increase of over 1,000,000 pounds, the bulk of the increase coming from the old camp of Hamilton. Eureka County was still first by over 1,500,000 pounds. Whitepine County, which was second in production in 1907, ranked fifth in 1906.

ZINC.

The production of zinc fell off slightly, from 2,886,328 pounds, valued at $176,066, in 1906, to 2,168,783 pounds, valued at $127,958, in 1907, a decrease of 717,545 pounds, valued at $48,108.

Lincoln County continued far in the lead, though the production in this county fell off almost 1,000,000 pounds. Elko, Humboldt, Washoe, and Whitepine counties entered the zinc-producing list for the first time.

Subdivision of tonnage of ore sold or treated in Nevada in 1907, by counties, in short tons.

County.	Dry or siliceous ore.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead.	Copper-zinc ores.	Lead-zinc ores.	Copper-lead-zinc ores.	Total.
Churchill	7,316	....	....	....	....	....	....	....	7,316
Douglas	24	33	....	....	....	....	....	....	57
Elko	39,970	491	104	....	....	....	1,594	372	42,531
Esmeralda	129,493	809	112	....	....	....	....	27	130,441
Eureka	299	....	34,823	....	1,141	....	....	95	36,358
Humboldt	2,422	6,004	61	....	86	....	....	65	8,638
Lander	1,147	2,131	1,067	....	118	....	....	....	4,463
Lincoln	127,625	519	150	4,342	27,754	5	....	240	160,635
Lyon	9,591	1,065	9	....	....	....	....	....	10,665
Nye	241,677	....	240	....	251	....	....	....	242,168
Storey	39,369	....	....	....	31	....	....	....	39,400
Washoe	28,967	19	....	....	....	....	9,630	....	38,616
Whitepine	601	29	771	....	802	....	....	90	2,293
Total	628,501	11,100	37,337	4,342	30,183	5	11,224	889	723,581
Increase	164,829	5,916	18,397	4,342	30,183	5	2,713	889	227,274
Average value per ton in gold and silver	$25.00	$6.65	$9.86	$1.17	$16.87	$0.80	$2.09	$25.81	$23.10

Number of mines, classified by chief product, in Nevada in 1907.

County.	Nonproducing mines.	Gold placer mines.				Deep mines.											Grand total.
		Hydraulic.	Drift.	Dry washing and sluice.	Total.	Gold.	Silver.	Gold and silver.	Copper.	Lead.	Zinc.	Copper-lead.	Copper-zinc.	Lead-zinc.	Copper-lead-zinc.	Total.	
Churchill	106					1	3	2								6	6
Douglas	21			1	1	1			1							2	3
Elko	64					5			2	2				1	1	11	11
Esmeralda	160					27	1		2	2					1	33	33
Eureka	15					1	2			6		1			1	11	11
Humboldt	150					4	3		2	2		1			1	13	13
Lander	34					2	1		3	3		1				10	10
Lincoln	135					12	3	1	4	6	2	1	1		1	31	31
Lyon	27					12			1	1						14	14
Nye	200	5		4	9	23	16			1		1				41	50
Storey	26					17	2	1				1				21	21
Washoe	23					7			1					1		9	9
Whitepine	46		2	1	3	4	2		1	3		3			1	14	17
Total	1,007	5	2	6	13	116	33	4	17	26	2	9	1	2	6	216	229

PRODUCTION OF GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA IN 07, BY COUNTIES.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Churchill	7,371.38	$152,380	655,480	$432,617		
Douglas	38.41	794	492	325	3,593	$719
Elko	7,046.79	145,670	34,464	22,746	164,592	32,918
Esmeralda	412,813.72	8,533,617	101,789	67,181	105,274	21,055
Eureka	8,424.36	174,147	252,889	166,907	144,825	28,965
Humboldt	2,983.00	61,664	31,488	20,782	118,793	23,759
Lander	4,211.38	87,057	143,535	94,733	615,544	123,109
Lincoln	44,977.87	929,775	58,259	38,451	244,179	48,836
Lyon	3,713.36	76,762	13,271	8,759	296,787	59,357
Nye	74,855.86	1,547,408	5,557,535	3,667,973	9,096	1,819
Storey	12,320.63	254,690	162,791	107,442	2,717	543
Washoe	3,690.96	76,299	15,932	10,515	8,350	1,670
Whitepine	2,863.41	59,192	55,678	36,747	68,821	13,764
Total	585,311.14	12,099,455	7,083,603	4,675,178	1,782,571	356,514

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
Churchill					$584,997
Douglas					1,838
Elko	137,795	$7,303	38,735	$2,285	210,922
Esmeralda	67,535	3,579	543	32	8,625,464
Eureka	2,992,117	158,582	3,075	181	528,782
Humboldt	58,880	3,121	19,046	1,124	110,450
Lander	701,312	37,169			342,068
Lincoln	290,766	15,411	1,892,984	111,686	1,144,159
Lyon	12,960	687			145,565
Nye	274,346	14,540			5,231,740
Storey	2,373	126			362,801
Washoe	256,067	13,572	200,000	11,800	113,856
Whitepine	1,477,190	78,291	14,400	850	188,844
Total	6,271,341	332,381	2,168,783	127,958	17,591,486

PROGRESS OF MINING INDUSTRY IN NEVADA IN 1907.

The increase of output of $1,876,645 in 1907, as compared with that of 1906, shows that Nevada is gradually making productive advances in its mining industry, but it may be confessed that a much larger yield was expected in view of the number of important mining enterprises being carried on in the more prominent camps, and the numerous discoveries being made in both old and new districts. It takes time, however, for these prospects to become productive mines, and for all the districts to prove their worth. The financial stringency in the latter part of 1907 had a disastrous effect on many new properties under development, as lack of money compelled numbers of them to close down just as they were about to become productive. The mines which produced had difficulties also, in the matter of high freight rates and smelter charges, and labor troubles in some instances affected production. In some camps where mines were under development, the "slump" in the mining-share market prevented sales of treasury stock, the proceeds of which were expected to yield money to continue work. This caused a good many properties to close down, and brought dull times to camps previously active. In several places ore was being mined and stored, waiting either for coming transportation facilities or the completion of local reduction works. This was due largely to cost of shipments to smelters, the companies preferring to wait for more advantageous conditions rather than to sacrifice their ore at small profit. Yet even with these and other disadvantageous circumstances, the output of all kinds of ore increased in Nevada in 1907, as compared with that of 1906, with a corresponding increase in value of gold, silver, copper, and lead. There is record of 229 producing mines, of which 216 were deep, as compared with 154 producing mines in 1906, of which 142 were deep. Nearly all the counties of the State now produce copper, and a very large increase in output of this metal will be seen in the future, as new and extensive mines have become productive since the close of the year, their reduction plants having been completed in 1908. These plants are of very large capacity.

It is to be noted that there is apparent a very marked diminution of the ore-shipping feature in several important districts, where mines with large outputs now have their own reduction plants. This feature will be even more noticeable in the report for 1908, since numerous reduction plants are to be constructed and put into operation in that year. Still others are being built or are planned. These are mentioned in the paragraphs on the individual counties of the State.

It is noteworthy, also, that the average value of all kinds of ore mined in Nevada is very high, though lower than it was in 1906. The gradual elimination of the leasing system in some of the great mines of Goldfield and other camps is responsible for this, as these lessees took out the best available ore only, and the companies mine more systematically and take the ore as it comes. In many camps, however, the lessees still continue to work, and, indeed, in some instances are doing almost the entire work in the mines.

The extension of railroad facilities to the districts of the State still continues, and several camps are awaiting their arrival in order to profit in their mining operations. As these camps become more self-supporting, however, more reduction plants will be locally established, thus doing away with the necessity of shipping the ores. It seems probable that persistent complaints about excessive freight rates and smelter charges have good foundation, since, for example, at several places no ore valued at less than $60 per ton is worth mining under present conditions, and at others little profit is left after paying railroad and smelter charges on classes of ore which would be considered high grade elsewhere.

Goldfield produces about 70 per cent of the gold yield of Nevada, and this proportion is likely to increase as its older mines become more productive and new ones begin to yield. There is an evident desire at this place and other established districts to drop the "high-pressure" conditions of recent years and to reduce costs. All points of economical working are receiving more attention than formerly. In some large productive properties foremen and underground miners are even brought in from the Mother Lode region of California, where they are accustomed to the economical systems involved in mining low-grade ore in which there is only a small margin of profit. In milling, also, careful study is being made by experts in the matter of accomplishing high extraction at low cost and with little waste.

In this connection it may be stated that the metallurgists at the 20-stamp mill of the Goldfield Consolidated Mines Company have made some remarkably successful practical experiments in treating sulphides by cyanide at a greatly reduced cost. In fact, by September, 1908, the results accomplished were so successful as to obviate, probably, the necessity of shipping sulphide ores to smelters, as each mine can treat its own for less cost than the usual freight rates alone. It is a chemical process, no mechanical appliances being necessary, and the plant is very inexpensive.

It has not been considered necessary in this brief review of the progress of the mining industry of Nevada to call attention to any of the marked conditions existing in the different districts, or even to generalize them, since they are all described in more or less detail in the paragraphs on the respective counties. It is proper to state, however, that great care has been taken to obtain from the companies complete returns for the full twelve months of the calendar year 1907, and it is these figures which have been used in this chapter. The published reports of some of the large producing companies in the State are made up by fiscal years, some of these fiscal years ending in August, some in November, and others in February. These printed official reports, therefore, do not always agree with the total returns for the calendar year obtained by the United States Geological Survey.

REVIEW BY INDIVIDUAL COUNTIES.

CHURCHILL COUNTY.

This county produced gold and silver valued at $584,997 in 1907, of which $432,617 was the value of silver from the three silver camps of Fairview, Wonder, and Stillwater. By far the largest producing mine was the Nevada Hills Mining Company, the sole producer at Fairview. To protect individual returns the three districts have been combined and only the total for Churchill County made public.

Fairview district.—Fairview lies close to the old overland trail. Wonder is 18 miles north of Fairview. To get to either camp a branch line, 16 miles in length, is taken from Hazen to Fallon, the headquarters of the government Carson Flat irrigation project, whence a stage line connects with Fairview, 42 miles in a southwest direction. The camp of Fairview lies on a gentle slope extending from the base of the Fairview peaks to the valley.

The principal mines are 3 miles from Fairview proper. The ore contains principally argentite, and yields in ratio of about 100 ounces silver to 1 ounce of gold. The country rock is andesite cut by later rhyolite and andesite dikes. The andesite is strongly silicified where fissuring has occurred. Faulting has taken place in a north and south direction.

Over 20 hoists were at work in the district in 1907. Water has been encountered at a depth of 200 feet on one of the properties. It is of good quality and may solve the problem of water supply.

Freight teams returning from Fairview to Fallon charged $12.50 per ton of ore, and as a consequence only high-grade ore was shipped. It is hoped that a railroad and mill will be built in 1908. The low-grade ore is stacked waiting the advent of a reduction works.

The Nevada Hills Mining Company has a shaft 200 feet deep and 5 tunnels. The ore, which runs 1 ounce of gold to 93 ounces of silver, has been found adaptable to milling. Some of the mines which have done considerable development are the Dromedary Hump Mining Company, with 3 shafts, one 250 feet and two 200 feet deep; the Eagles Nest Fairview Mining Company, which was shipping ore in 1907; the Fairview Aztec, which has struck water at 200 feet and is expected to produce in 1908; the Fairview Eagle, with a shaft 200 feet and over 1,000 feet of tunnel, which shipped just enough ore in 1908 to cover development expenses. Other properties in 1907 which gave promise of results in 1908 were those of the Cyclone Mining Company, the Coxey Gold and Silver Mining Company, Consolidated Mines Company, Fairview Clipper, Ida Mines, Mispah, Nevada Fairview, Highland Chief, and Wyoming Fairview mines.

Wonder district.—Wonder lies 18 miles north of Fairview, and had a population of 3,000 in the early part of 1907. The town lies on a sloping mesa, on the southeast corner of the mineralized district. The ore is very similar to that of Fairview, containing argentite with some free gold in country rock of andesite. The ratio in weight is about 1 ounce of gold to 240 ounces of silver. Over a dozen shafts are in evidence, but the freight charges are even more excessive from Wonder than from Fairview. Several properties are down 500 feet and several companies are considering the erection of mills. Much low-grade ore is reported to be blocked out. A good supply of water is piped to the town, and wood is easily obtained.

The producers in the camp in 1907 were the Jack Pot, Nevada Wonder, and Spider and Wasp mines. The Jack Pot was developed by a shaft 315 feet deep and by 3,000 feet of crosscutting and drifting. The Nevada Wonder shaft was 500 feet deep. The Spider and Wasp was worked by lessees. At the Ruby Wonder mine considerable development work was done in 1907, as also at the Wonder Extension, June Wonder, Lost Chord, Wonder Queens, and Vulture mines. The money depression in the fall of 1907 caused a cessation of all operations during the latter part of the year, but in February, 1908, several small shipments were made from the Nevada Wonder mine, and a shipment followed from the Jack Pot mine. The Nevada Wonder Company is planning to build a mill.

Stillwater district.—Considerable silver ore was shipped from Stillwater district by the Silver Queen Mining Company before closing down in April, 1907. The ore was mined from open cuts. Th Black Prince mine made several shipments of ore.

There was also some activity in the White Plains district, but no production.

DOUGLAS COUNTY.

Douglas County made a very small production from the Buckskin district and from a small placer mine in the Silver Lake district.

Several old properties were reopened and some new companies organized in the Gardnerville district. The Orpheus mine, a former producer, was reopened, and a 2-stamp mill was put in operation in 1908. Development work was done on the mine of the Douglas Mining and Reduction Company. It was planned to reopen the Bismark mine in 1908. The property of the Longfellow Mining and Milling Company is equipped with a 7-stamp plate-amalgamation mill, with concentrator. This company only did development work on its 8 claims in 1907, but expects to be a steady producer in 1908. The Big Frank mine of this company has been equipped with a gasoline hoist and an air compressor. The Pinenut Mines and Development and Power Company, a new concern, erected a 5-stamp mill at the close of the year. The company owns a large acreage. The Nevada Gold Placer Mining Company was reorganized and is now called the " Success Mining Company of Nevada." Hydraulicking is to commence in the summer of 1908.

Some lead, silver, and zinc properties were opened up near Wellington, Lyon County, on the line between Lyon and Douglas counties.

ELKO COUNTY.

The value of the output of Elko County in 1907 was $145,670 in gold, $22,746 in silver, $32,918 in copper, $7,303 in lead, and $2,285 in zinc, a total of $210,922, and an increase of $2,369 over the output of 1906. This total was the product of 11 mines, with a total tonnage of 42,531, of which only 1,061 tons were shipped to smelters, the rest being treated by mills at the mines.

Aura, Edgement, Mountain City, and Tuscarora districts.—To the north of Elko are the mineral districts of Tuscarora, Aura, Edgement, and Mountain City. At Mountain City the Protection Mining Company was the principal producer. The mine is equipped with a 10-stamp plate-amalgamation mill, with concentration. Some crude ore was shipped to the smelter in 1907. The company has 2,400 acres of ground reported to be mineralized. The Nelson Mining Company, equipped with a 15-stamp Merrill mill and 3 Wilfley tables, made a small test run. This mine has been in litigation for two years. The Hall mine made a small production, and the Scaggs property was said to have made a small shipment, but no report could be obtained. At Aura the Aura King Gold Mining Company worked 4 mines. The company has a 5-stamp mill, with plate amalgamation and concentration. A shipment of lead-silver ore was made from the Astor Group and from the Double Eagle.

At Edgement, 4 miles from Aura, is the 20-stamp plate-amalgamation mill, with concentration, and 60-ton cyanide plant of the Montana Mining Company (Limited). This mine is the largest producer in the county. The company owns valuable water rights, and the plant is operated by electricity.

The old camp of Tuscarora promises to be rejuvenated in 1908. Twenty years ago the mines of the camp were well known on the San Francisco Stock Exchange. Some of these are the Navajo, Grand Prize, Columbia, Infidel, Dexter, North Belle Isle, and De Freese. It has been estimated that these veins produced many millions when formerly worked. The district has again taken life after lying almost idle since the seventies. The old methods of extraction were costly; the companies were many and under separate and extravagant management. The mining and treatment cost per ton in early days was never under $18 and seldom under $35. All ore under $35 was thrown on the dumps. The plans are to work the dumps by the cyanide process and to reopen the mines for free-milling and cyanide treatment.

The Tuscarora-Nevada Mines Corporation has been formed to work these old properties under one combination. The holdings of the company consist of 80 odd claims, a 40-stamp mill, and cyanide plant. Both are to be repaired and put in order in 1908. The new company asserts that there are on old dumps alone 4,800,000 tons of ore available in Tuscarora, on which a profit of $1.50 can be made, taking the average value of the ore at $3.50. The deepest workings of the old mines are down to 700 feet. The Dexter is down 250 feet. This mine is equipped with a hoist in good condition.

There was considerable production from this camp in 1906 from the milling and cyaniding of old tailings, but no work was done in 1907. The company also has 2,000 acres of placer land, said to run 13.47 cents per cubic yard. The Hydraulic Mining and Milling Company likewise has considerable placer holdings at Tuscarora and a water right on McCann Creek, 3 miles away.

Between Elko and Tuscarora is Lone Mountain, which district shows good values in copper and lead. Several properties there are being developed.

Spruce Mountain district.—Before the Nevada and Northern Railroad was opened the freighters took the road from Wells through the fertile Clover Valley, then out into the desert to Cherry Creek and Ely. This road passed within 3 miles of Spruce Mountain, where considerable work was done in 1907. The mountain of dolomitic limestone is cut from east to west by a huge dike of rhyolitic rock. The camp is a good producer of lead and silver, found in the limestone, but during the last year the mining of copper has been the main work. The mines are yet only in development, but rich copper oxide and native copper were shipped by the Spruce Mountain Copper Company during the year 1907. As yet only the oxides of copper have been found at a depth of 107 feet. The Black Forest Mining and Smelting Company on Spruce Mountain operates a lead-silver mine, whose principal ore is lead carbonate and lead arsenate. The ore is very basic and is not sent to a custom smelter but treated in a small 20-ton coke smelter on the property. The ore contains 20 per cent of lead and 18 ounces of silver. No ores were treated in 1907, but considerable development was made. Some copper ore has been opened up on this property. The Big Four Copper Company expects to work in 1908. The Western Pacific Railway will have a station within 15 miles of Spruce. The nearest railroad point now is Wells, at a distance of 58 miles.

Opposite Spruce Mountain are the Ruby Mountains, very little prospected, but reported to show good copper values. Dolly Varden, in the Antelope Range and about 100 miles south of Wells, has some good copper prospects.

Railroad district.—This old camp of 1869–1884 had two producers in 1907. The Standing Elk mine of the Nevada Bunker Hill Mining Company was worked by lessees, who shipped to Salt Lake City 22 cars, averaging 20 ounces of silver, 10 per cent of lead, 5 per cent of copper, and 5 per cent of zinc. The company has a wagon haul of 10 miles to Raines siding on the Eureka and Palisade Railway. The camp is 28 miles from Elko, and connected with that place by a good wagon road. The Sweepstake-Como mine made several shipments in 1907, and in 1908 opened up some higher grade ore. Development has gone on steadily.

Tecoma district.—Tecoma, on the Southern Pacific Railroad, is about 60 miles from the Utah line. During the summer of 1907 there was quite a rush into this country, and the whole district from the railroad to Contact was staked out. N. S. Jackson shipped considerable lead ore from his mine 10 miles north of Tecoma.

Gold Circle district.—At Gold Circle, 60 miles north of Golconda, is another new camp of the last few months of 1907. An area of 12 square miles was covered with claims in September, 1907. The ore is found in a honeycombed quartz with hematite and carries high values in gold. The ore is free milling and water is abundant. Not only are the ledges reported to be rich, but the placers are expected to be very productive. Wood is scarce and the winters are cold. During the spring of 1908 considerable work was done at this camp, to which the Post-Office Department has given the name of Midas. It is reported that ore was shipped from several properties, and the Gold Crown Mining Company has erected a mill. Other properties are the Golden Chariot, the Elko Prince, and those of the Nevada Gold Circle Mining Company. The camp lies on Rock Creek in a straight line between Golconda and Tuscarora, and near the old post-office at Fairlawn.

ESMERALDA COUNTY.

Metallic production of Esmeralda County, Nev., in 1906 and 1907.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
1906	344,677.63	$7,125;119	141,975	$95,123	180,000	$34,740
1907	412,813.72	8,533,617	101,789	67,181	105,274	21,055
Increase (+) or decrease (−).	+68,136.09	+1,408,498	−40,186	−27,942	−74,726	−13,685

Year.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Pounds.*		
1906	676,510	$38,561			$7,293,543
1907	67,535	3,579	543	$32	8,625,464
Increase (+) or decrease (−).	−608,975	−34,982	+543	+32	+1,331,921

From these figures it may be seen that Esmeralda is by far the most productive county in Nevada in total yield, its output for 1907 having been 49 per cent of the total of the entire State. The output of 412,813.72 fine ounces of gold, valued at $8,533,617, in 1907, was greater by $1,408,498 than in 1906. The output of silver and copper declined to some extent and a material falling off is shown in the lead, viz, 608,975 pounds, with a decreased value of $34,982 as compared with 1906. There was a small quantity of zinc produced in 1907, whereas there was none in 1906. The total gain in value amounted to $1,331,921. With 33 producing mines, as compared with 26 in 1906, there were mined 130,441 short tons of ore, as against 71,883 tons in 1906. Of this total quantity, 129,493 tons were siliceous ore, 809 copper ores, 112 lead ores, and 27 tons copper-lead-zinc ores, the siliceous ore yielding almost all the gold, the amount from that source having been $8,532,777 in 1907. This class of ore also yielded $59,120 of the silver out of the total for the county of $67,181.

In Esmeralda County is Goldfield, the most productive and important district of the State. The other districts are Aurora, Buena Vista, Hawthorne, Buckley, Lida, Hornsilver, Luning, Candelaria, Mina, Pinegrove, Silver Peak, and Thorp.

Aurora district.—In the sixties Aurora, close to the borders of California, not far from Bodie, Mono County, Cal., was an exceedingly prosperous and productive district, with a large population and several mills of good capacity. On the exhaustion of the high-grade ores of the camp it was abandoned and lay idle many years, the only work done being in treating the old tailings from former milling operations. In 1907 the only producer of moment was the J. S. Cain Consolidated Gold Mining Company, working the Aurora mines, which include the Prospectus, Wide West, Northern Belle, Juanita, Real del Monte, and Durand claims. The property is equipped with a 20-stamp mill, without concentrators. The California Exploration Company, which had no yield in 1907, expects to erect a 20-stamp mill, with a cyanide plant, in 1908. The work so far has been confined to development, and they now are reported to have over 4,800 feet of work on vein matter from over 30 openings. The principal properties owned by this company are the Eva, Ophir, Sunny Jim, Clarence, Monarch, Columbian, and Seminole claims. The production of the camp in 1907 was not large.

Buena Vista district.—This district, also known as Oneota, had a small yield in 1907. The Indian Queen mine comprises a group of several locations, worked from 1 tunnel 1,000 feet long. The output is sold to the American Smelting and Refining Company. The Brownie Mining Company was developing in 1907 and expects production in 1908. The Buena Vista Mining Company is preparing to erect a 10-stamp mill. The ore is of low grade, but reported plentiful.

Goldfield district.—Goldfield is the most important district in Nevada, considering productiveness, population, reduction works, and the number of mines operated. The camp is situated 24 miles south of Tonopah in the southern rim of one of the typical desert basins of the region. The early discoveries in the district did not give much indication of the wealth it was eventually to produce, and what has since proven to be the richest ground was not located by the earlier prospectors. With few exceptions all the mines of importance were first opened and developed by the leasing system, as many of the rich ore bodies were found near the surface. The railroad from Tonopah was completed to Goldfield in September, 1905, so that since that time it has enjoyed transportation facilities. Much has been written on the geology and ore deposits of this district.[a] Therefore it is not necessary to consider these subjects in this place. The metallurgical features of the camp are given at the close of this chapter.

The production of Goldfield district in 1906 and 1907, with increase for the latter year, is given in the following table in fine ounces and value:

Production of Goldfield district, Esmeralda County, Nev., in 1906 and 1907 in fine ounces.

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1906	339,890.20	$7,026,154	15,648	$10,484	$7,036,638
1907	406,756.16	8,408,396	71,710	47,329	8,455,725
Increase	66,865.96	1,382,242	56,062	36,845	1,419,087

This total increase valued at $1,419,087 for the year is quite substantial, especially in view of the fact that the financial stringency during the year put a stop to certain development work which might otherwise have resulted in further production. The ore treated in 1907 was all siliceous, and in quantity was 101,136 tons, as compared with a production of 59,628 tons in 1906—an increase of 41,508 tons. This total tonnage yielded $8,408,396 in gold, which is $1,382,242 more than was obtained from the 59,628 tons worked in 1906. On the same basis of comparison the silver yield showed an increase valued at $36,845.

Of the total of 101,136 tons of ore treated, 17,782 tons were milled, yielding $595,483 in gold and silver valued at $5,651, a total value of $601,134. The 434 tons of concentrates obtained from 17,782 tons of milling ore yielded $195,231 in gold and silver valued at $2,057, a total value of $197,288.

The value recovered from ores milled therefore was $798,422 in gold and silver, or an average in gold and silver of $44.90 per ton. Crude ore shipped to smelters amounted to 83,354 tons, which contained $7,617,682 in gold and $39,621 in silver, a total in gold and silver of $7,657,303, or an average of $91.86 per ton in gold and silver. The general average value of the 101,136 tons of Goldfield ores treated at both mills and smelters in 1907 was $83.61 per ton in gold and silver.[b] In the future much less of the ore will be shipped to smelters as the milling capacity of the camp is rapidly increasing.

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[a] J. E. Spurr, Bull. U. S. Geological Survey No. 225, 1904.
J. E. Spurr, Bull. U. S. Geological Survey No. 260, 1905.
F. L. Ransome, Bull. U. S. Geol. Survey No. 303, 1905.
Sydney H. Ball, Bull. U. S. Geol. Survey No. 308, 1907.
J. B. Hastings and C. P. Berkey, Trans. Am. Inst. Min. Eng., 1906.
Edgar A. Collins, Min. and Sci. Press, September 28, October 5, 1907.
T. A. Rickard, Min. and Sci. Press, May 30 and June 20, 1908.

[b] By recovery in the case of the milling ores and by assay value of the smelting ores.

The following table shows the production of gold and silver in the Goldfield district from the time it became productive up to the end of 1907:

Production of Goldfield district, Esmeralda County, Nev., from its inception in 1903 to 1907, inclusive, in fine ounces.

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1903	3,418.66	$70,670	287	$155	$70,825
1904	113,293.23	2,341,979	19,954	11,374	2,353,353
1905	91,087.76	1,882,951	8,589	5,188	1,888,139
1906	339,890.20	7,026,154	15,648	10,484	7,036,638
1907	406,756.16	8,408,396	71,710	47,329	8,455,725
Total	954,446.01	19,730,150	116,188	74,530	19,804,680

The most important and most productive mines in the camp are those owned by the Goldfield Consolidated Mines Company. It was organized in November, 1906, and in March, 1907, acquired control of the Combination Mines Company and operated that company as a subsidiary until June, 1907, when it finally absorbed the Combination Company. The properties owned and controlled by the Goldfield Mines Company are those of the Combination Nos. 1, 2, and 3, Hazel, Queen, Rustler, Fraction, Golconda, Goldstone, Mammoth, Wonder, Red Boy, Victor, Sideline Fraction, O. K. Fraction, Goldfield Mohawk Mining Company (Mohawk Nos. 1 and 2 and Slim Jim Fraction), Red Top Mining Company (Red Top and Little Red Top), Jumbo Mining Company (Jumbo, Clermont, Grizzly Bear, and Lucky Boy), Laguna Goldfield Mining Company (Laguna, Miss Jessie, Last Chance), and Goldfield Mining Company (January and February). Development in 1907 up to November 1 was on the Red Top, Laguna, Laguna leases, Jumbo, Combination, Combination leases, Goldfield Mining Company leases, Mohawk mine, and Mohawk leases, and amounted altogether to 32,354 feet, or 6.1 miles, not including stope work. This total included 8,983 feet of shafts, 10,563 feet of drifts, 11,316 feet of crosscuts, 1,124 feet of raises, and 368 feet of winzes. Considerable work has been done in these mines by lessees, and it has been necessary to make a considerable expenditure in repairing, timbering, and restricting caving areas of the old lease workings in different properties. During 1907 ore shipments were curtailed, production interrupted, and expenses increased by strikes in mines and railroads. The excessive charges made for shipping ore to smelters induced the management to begin the construction of a 100-stamp mill, which will be completed before the end of 1908.

In the process of prospecting for and developing profitable ore bodies a great quantity of milling ore has been disclosed, and the new mill will treat the bonanza and the low-grade ores together. The Combination and Kinkead mills, owned by the company, were too limited in capacity to handle all the ores mined, and the larger part was shipped to smelters.

The following statement concerning the ore bodies in these properties is taken from the annual report of the company, dated November 1, 1907:

> In the "Announcement" a year ago (1906) the following statements were made:
>
> In the Mohawk No. 2, the bonanza ores have been found continuously from the south end-line northward for a distance of nearly 600 feet along the claim, and complete development promises to show their connection with similar bodies recently discovered in the Kalfus lease 600 feet away. In fact, it now begins to appear that the series of remarkably rich ore bodies in the Combination, January, Combination, Fraction, Mohawk, Jumbo, and Red Top will soon be definitely correlated as an articulated system of veins due to the same causes and together forming a system.
>
> Strictly speaking, the bonanza ore-shoots are only extraordinary rich segregations within greater masses of quartz deposits which range from a few feet to more than 100 feet in width, commonly called "ledges." Millions of cubic feet of such material have been developed in the breccia zones, which everywhere contain gold values. Such bodies are the great veins of Goldfield, and, when company milling is fully instituted, a great portion of these masses will be milled at good profit. Such is their extent that a supply of mill ore is assured for a period of many years after the rich ores have been extracted.
>
> The underground developments and geological study of the past year (1907) have only served to render more definite the conception of these veins as above expressed, and to articulate their parts still more closely as great lodes made up of immense elongated masses of quartz or silicified material in breccia fissures of great width, surrounding large irregular horses of porphyry, yet nowhere so far as developed interrupted in their continuity as a fissure system.
>
> The Mohawk-Combination and the Jumbo lode systems now appear to diverge and become distinct to the south on their strikes, but they apparently unite northward in the Mohawk No. 2 and Red Top claims.
>
> The new west body in the Red Top and the longer known bodies in the old workings stand in the same relation as the Mohawk bodies; also the Combination, January, and February quartz bodies may be regarded as the southward continuation of the same lode. None of the quartz bodies on the hanging or foot wall sides, or the connecting masses between, could be isolated or defined for any great distance as separate vein deposits. Taken together they form a system of fissuring and a system of vein deposits due to the same causes acting over the same geological periods.
>
> The low-grade distributed values for great width in the quartz bodies, also the ramifying internal bands of high grade and the larger bonanza segregation, as 307-stope in the Mohawk, are the result of continuously operating and intensely active solutions which naturally effected the richest precipitation in the more open parts of the lode.
>
> On account of the comparatively recent deposition of the lodes, erosion has been only moderate. It is probable that the outcrops have not been reduced more than 750 feet below their original position. Only a relatively small part of the ore deposits have therefore been removed and dissipated over the plains surrounding the district.
>
> All these considerations are marked evidence that mining may be pursued to great depths, and this is also assured by the visible promise shown in the deepest developments.
>
> Sufficient underground work has been accomplished already to make it positive that the Goldfield district may have geological features peculiar to itself and not strictly resembling any other, yet commercially speaking, it now begins to appear that it is possibly the greatest gold district yet discovered on this continent.

The Florence Gold Mining Company has, next to the Goldfield Consolidated, the most productive properties at Goldfield, and the output by the company and the lessees was quite large in 1907. The company's shaft is 350 feet deep, with about 12,000 feet of horizontal workings. In addition, 18 lessees have about 25,000 feet more development work done. The ore was shipped to smelters in 1907, but a 40-stamp mill has since been constructed, with plate-amalgamation, concentrators, and cyanide plant. The Jumbo Extension

Mining Company has about 2,000 feet of shafts, of which the deepest is 500 feet, and about 10,000 feet of drifts. All the ore is shipped. The Combination Fraction, St. Ives Gold Mining and Milling Company (Codd lease), and Gold Bar Mining Company are other producers of note. In the Diamondfield section of the district the producers are the Quartzite and Black Butte and Goldfield Daisy mines. A number of returns were obtained from men who were working small leases at various mines.

There is a large number of nonproducing mines in the district, upon some of which more or less development work is being carried on. In the properties of the Atlanta Mines Company a number of lessees operated, but no ore of commercial value was developed. The Albermarle Mining Company prospected and finally opened a vein. The Black Ant Mines Company did active work, but developed no ore. The Kewana Mining Company did over 3,000 feet of work and had 7 lessees on the property, one of whom had a shaft down 400 feet and another a shaft down 300 feet.

The Goldfield Monarch Mining Company spent about $10,000 in development work without thus far discovering ore. It has 4 vertical shafts from 40 to 150 feet deep, and 4 tunnels from 50 to 300 feet long. The Goldfield C. O. D. Company obtained some ore, but none was reduced. The Goldfield Great Bend Mining Company has a 300-foot shaft and about 1,500 feet of other development work. In the Empire Goldfield Mining Company, lessees have been operating, but no shipping ore was developed. There are numerous prospects and small mines in this extensive camp. Since the close of the year many changes in ownership have taken place, and certain important mergers or combinations of claims have been made, details of which belong in a subsequent report.

Mr. F. L. Ransome, writing of conditions as they were in 1905, summarizes the occurrence at Goldfield as follows:

> The deposits hitherto of most importance in the Goldfield district are irregular bodies of rich oxidized gold ore. These have been derived from sulphide ores, of more or less complex mineralogical character, in which pyrite is accompanied by minerals containing copper, silver, antimony, arsenic, bismuth, tellurium, and other elements. The most notable features of the oxidized ore bodies are their remarkable richness and their equally remarkable irregularity. The ores are almost without exception associated with craggy outcrops of silicified volcanic rock, although only a very small proportion of these outcrops, which are extraordinarily numerous and constitute the most striking superficial feature of the district, have been found productive. Associated with the silicification, other processes of locally intense alteration have also been active, producing in many cases a softening of the rock affected and thus serving to accentuate the silicified portions under the selective action of erosion. The deposits have formed along zones of fissuring which, for the most part, are very irregular in trend, are rarely traceable in any one direction for more than half a mile, and are not planes of notable faulting. Branching and intersection are very common. Many of the outcrops show no linear character, being mere irregular knobs of siliceous material. Some of these probably represent silicification at the point of intersection of two or more inconspicuous approximately vertical fissures. Others are erosion remnants of nearly horizontal silicified zones and, as in the case of Black Butte, merely cap the hills whose summits they form.[a]

Hawthorne and Buckley districts.—There are 2 productive mines at Hawthorne, those of the Big Injun Mining Company and the Gleason; and at Buckley (Walker Lake) is the property of the Margaret-Nevada Mining Company. This latter company has 3 shafts from 95 to 252 feet deep, and has about $40.000 worth of ore on the dumps. The nearest water is at Walker Lake, 7½ miles distant. The ore is not rich enough to ship at fair profit, and the company may pump water from the lake or build an aerial tram to treat the ore at the lake. The Esmeralda Consolidated Mines Company, at Hawthorne, made no product, though it has a 20-stamp plate-amalgamation mill. In the Owl mine search is being made for the ledge cut off by the fault years ago. The entire production of these two districts was small in 1907.

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[a] F. L. Ransome, Bull. U. S. Geol. Survey No. 303, 1907.

Lida and Hornsilver districts.—The Mariposa Lily and Mariposa Rose property at Lida (or Tule Canyon) district yield high-grade, free-gold ore. Some of it is sold to jewelers at Goldfield, who make it up into jewelry. At these mines some tungsten ore is found also. Other producing mines in the district are the Lida Queen Mining Company and the Jones. In the Goldfield Tunnel and Mining Company a good ledge of 26 per cent copper ore was opened, but no ore was shipped in 1907. The placers in Tule Canyon are operated by Chinese, but they are pretty well worked out. There are numbers of mining locations at Lida, but very little work is being done. In Hornsilver district the Great Western Gold Mining Company is the only producer, its ore being shipped. Since the close of the year a great deal of work has been done by companies and lessees, and ore is being shipped.

Luning, Candelaria, and Mina districts.—At Luning the Nevada Champion Coppper Company has no plant and shipped its ore, carrying copper and silver. At Mina the property of the Douglas Mining Company is developed by 2 tunnels and a shaft. There are 15 claims in the group, and there is a 5-stamp mill and small cyanide plant on the property. The Blue Light Copper Company is well developed and is shipping. The property of the Nevada Lead Mines Company is developed by a shaft 250 feet deep and drifts and tunnels aggregating 3,000 feet. The ore is shipped to Reno. The Marietta mine (Marietta district, near Mina) is being developed and is equipped with a 75-ton amalgamation mill and concentrating tables. The ore is crushed by crushers and rolls. No ore was treated in 1907, pending the completion of the mill. At the old Candelaria district (Rhodes P. O.) the Humboldt Consolidated Mining Company is the only producer. Numerous mines at this place were idle in 1907, but the Georgine and Mount Diablo are expected to produce in 1908. At the Potosi a tramway is being installed.

Pine Grove district.—At this place the Nevada Rockland Mining Company had a dry-roller crushing and cyaniding plant of 60-ton capacity, but being unsatisfactory it was closed down in September, 1907. The property is well developed and producing gold and silver ore. The Wheeler Gold Mines Company, another producer, has a 5-stamp mill and a concentrator. Since the close of the year the interests of the Nevada Rockland Mining Company have been purchased by the Goldfield Syndicate Mining Company.

Silver Peak district.—This district was discovered in 1864, and between that time and 1869 numbers of gold and silver mines were located and worked. A 30-stamp mill was put up in the camp in 1867, but after working two years it was idle until sometime in the eighties, when it was leased for a few years and again was idle until 1893. After starting up then, litigation finally closed it down. Some intermittent mining was done on the claims, most of which were of minor importance except the Blair group. The geology, metalliferous deposits, and mines of this camp have been very fully described by J. E. Spurr.[a]

Since the discovery and development of Tonopah considerable attention has been given to Silver Peak district (Red Mountain district), though there has been only one producer of note, and that in 1907. This is the Pittsburg Silver Peak Gold Mining Company at Blair, which is developed by a main tunnel 2,500 feet long, crosscuts, and upraises. The company operates the properties of the Mohawk Alpine Mining Company and the Silver Peak Gold Mining Company. It placed in commission in November, 1907, a 100-stamp mill for treating its low-grade ore, and in March, 1908, a cyaniding plant, which are described at length in the concluding portion of this chapter on Nevada. Among mines under development at Silver Peak, but not producing, are those of the Apex Group, Silver Peak, and Drinkwater Gold Mining Company, and Silver Peak Blue Jay. There are numbers of other mines on which little or nothing was being done in 1907. The building of the big mill, however, has called more attention to the mines of this district. This mill is of excellent construction. The process is crushing in stamps, amalgamation, and cyaniding. The tailings from the plates are classified; the sand is treated by percolation; the slime, after agitation in cyanide solution, is filtered in Merrill slime presses similar to those in use at the Homestake mine, South Dakota. The gold is precipitated on zinc dust in Merrill precipitation presses, and the resulting zinc slime is briquetted and reduced to bullion by the Merrill cupellation process as used at the Homestake plants.

Thorp district.—At this place there was in 1907 only one producer, the Bonnie Claire Mining and Milling Company, which has a 10-stamp plate-amalgamation mill with concentrators and a cyanide plant. The property consists of 3 groups containing 14 claims, and is reported to be well developed. The mill was used partly on custom ores from Goldfield in 1908. There is a railroad station called Bonnie Claire on the Bullfrog and Goldfield Railroad.

Other districts.—Acme City, lying between Luning and Hawthorne on the railroad, has a few mines in process of development. Among probable producers in 1908 are the Arizona Nevada Mining and Milling Company and the Norwich mine, owned by the American Smelting and Refining Company. At Palmetto the mines were unproductive in 1907. At Sweetwater there are a number of properties being developed, and there is a small mill on the Tananak mines. Granite Camp, 8 miles west of Schurz, began producing in August, 1908, about 55 lessees being at work. The Wilson Gold Mines Company has a mill on the Walker River, and the Golden Age is installing a mill. Shafts 115 feet deep have been sunk on the Big Twenty ledge. The Walker River Mines Syndicate have extensive copper properties about a mile west of Granite.

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[a] Spurr, J. E., Ore deposits of Silver Peak Quadrangle, Prof. Paper U. S. Geol. Survey No. 55, 1906.

Regent (*Rawhide*) *district.*—The old freight road from Wadsworth to Candelaria had been traveled by prospectors for years, but not until late in 1907 was the value of the district around what is now called Rawhide realized. Locations were made in December, 1906. In October, 1907, there were probably not more than 150 people in the district. In the spring of 1908 the rush took place, and at once time there were probably 4,000 inhabitants in the town. The main street of the town is the old freight road, and the mines lie closely on both sides. The district lies in the northeast corner of Esmeralda County, near Churchill County line and some miles southwest of the old Eagleville lead-silver district. The camp is about 40 miles southeast of Fallon, Churchill County, and 25 miles east of Schurz, Esmeralda County. Both towns are supply points for the new camp. Water is obtained in wells in the flat east of Rawhide, at a distance of from 3 to 4 miles.

> The rock containing the deposits is a rhyolite, locally much silicified or kaolinized. The ore minerals are free gold, alloyed with much silver in places, also argentite and ruby silver. There are also later flows of fine-grained andesite and rhyolite containing biotite. As far as developments go, the gold is mainly native, of rather pale color, and accompanied by some silver minerals. It occurs in veins often ill defined, most of which trend N. 20°–40° W., and consist of kaolinized rhyolite penetrated by seams of quartz. In places the gold is contained in the clayey rhyolite, and this may be extremely rich. At other occurrences it may be found in druses in hard quartz. Both coarse and extremely fine gold are present. There are indications of another vein system coursing in a northeasterly direction. In April, 1908, the outlook seemed promising for a fair production when milling facilities could be obtained. Some extremely rich clayey ore was seen in the Kearns No. 1 and Kearns No. 2 leases.[a]

The leasing system flourishes at Rawhide. Few of the companies owning the ground are doing any development work themselves. The best-known properties are as follows: The Rawhide Queen Company, on Balloon Hill, with as many as 19 leases, among which are the original Rawhide Mining Company (Kearns No. 1), Kearns No. 2, and the St. Ives; the Rawhide Consolidated Company, which owns the ground on the southeast part of Balloon Hill, and among whose lessees are the Big Four and the Murray (Rawhide Mining and Reduction Company). On Hooligan Hill, west of the town, is the property of the Rawhide Coalition Company. On this is the Miller lease, belonging to the Nevada Rawhide Gold Mining Company; also the Truett lease. In the northern end of the town is the Last Chance claim of the Rawhide Mining Company. Still farther north is the IXL property of the Rawhide and IXL Leasing and Mining Company. The claims of the Royal Tiger Mining Company are located 1¾ miles west of the town in a separate part of the district. A number of lessees were at work here early in 1908. Small shipments of rich ore from several properties began in 1908.

EUREKA COUNTY.

Eureka County in 1907 more than trebled its production of 1906. The value of the yield was $174,147 in gold and $166,907 in silver. There were also produced 144,825 pounds of copper, valued at $28,965; 2,992,117 pounds of lead, valued at $158,582; and 3,075 pounds of zinc, valued at $181. This gives a total value of $528,782, as compared with $161,996 in 1906, an increase of $366,786. The production of 1906 was double that of 1905.

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[a] Unpublished notes by W. Lindgren.

Metallic production of Eureka County, Nev., in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1906	2,462.82	$50,911	77,552	$51,960	6,653	$1,28	1,014,244	$57,812	492	$30	$161,996
1907	8,424.36	174,147	252,889	166,907	144,825	28,965	2,992,117	158,582	3,075	181	528,782
Increase	5,961.54	123,236	175,337	114,947	138,172	27,682	1,977,873	100,770	2,583	151	366,786

Eureka district.—Nine of the 11 producers of Eureka County were located at Eureka and less than $100,000 of the $528,782 produced came from the 2 mines in the other districts. There was a general increase in tonnage from all the silver-lead mines at Eureka, but the Eureka-Richmond Consolidated continues to produce the bulk of the output. The tonnage of the district increased from 11,896 tons in 1906 to 35,092 tons in 1907.

The Bullwhacker Mining Company and the Diamond Mining Company shipped ore to the American Smelting and Refining Company. The Auro and Cyanide, two adjoining claims, shipped to Selby at Vallejo Junction, Cal. The Eureka-Richmond Consolidated, with 3 vertical shafts, one 720 feet deep and the others 1,200 feet each, shipped to Salt Lake, Utah. The Ruby Hill Mining Company, the Phœnix Silver Mining Company, and the Adams Hill Mining Company were also shippers in 1907. J. McNaughton continued to ship lead-carbonate ore from the Laurel mine. The Lincoln Mining Company, commencing operations in December, 1907, treated 150 tons of ore in their 150-ton concentrating plant and shipped the concentrates to Salt Lake.

Both the Eureka-Richmond Consolidated and the Phœnix Silver Mining Company recovered copper from their ores, and some zinc was recovered by the last-named company.

Metallic production of Eureka district, Eureka County, Nev., in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		*Pounds.*		
1906	2,396.01	$49,530	68,760	$46,069	6,653	$1,283	992,929	$56,597			$153,479
1907	8,370.62	173,036	152,873	100,896	115,557	23,111	2,936,672	155,643	3,075	$181	452,867
Increase	5,974.61	123,506	84,113	54,827	108,904	21,828	1,943,743	99,046	3,075	181	299,388

Cortez and Palisade districts.—The Tenabo Mining and Milling Company, in the Cortez district, shipped to smelters in 1907. The mine is developed by a 480-foot upraise and tunnels, and a considerable body of low-grade ore has been reported to be opened up. As yet no way of treating the low-grade ore on the ground has been provided and only picked ore is shipped. The Flagstaff mine, in this district, was a nonproducer in 1907.

The Zenoli Silver-Copper Mining Company, at Palisade, shipped considerable ore containing silver, lead, copper, and a small amount of gold.

HUMBOLDT COUNTY.

A decided increase in activity in the camps of Fitting, Golconda, Humboldt House, and Mills City, and the advent of the Seven Troughs district into the rank of producing camps, raised the value of the production of Humboldt County from $23,086 in 1906 to $110,450 in 1907, an increase of $87,364. The increase was general and was made in all the metals, as is shown in the following table:

Metallic production of Humboldt County, Nev., in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		*Pounds.*		
1906	774.49	$16,010	9,030	$6,050	518	$100	16,250	$926			$23,086
1907	2,983.00	61,664	31,488	20,782	118,793	23,759	58,880	3,121	19,046	$1,124	110,450
Increase	2,208.51	45,654	22,458	14,732	118,275	23,659	42,630	2,195	19,046	1,124	87,364

Fitting district (in Humboldt Mountains).—During 1907 very little was done in this camp, but the prospects look better for 1908. The Bonanza King mine was worked, and the ore treated in the 15-stamp mill on the property. The mine is down 300 feet. The Humboldt Queen mine, of the Lone Mountain Mining Company, which is developed by a shaft 200 feet deep and by approximately 700 feet of crosscuts and drifts, made a shipment to the Mountain Copper Company, Shasta County, Cal. Several reorganizations have taken place in this district, and a new strike has been made at Star Peak. The Federal Mining Company expects to install a dredge on its property. The Dry Gulch Placer Mining Company did not produce in 1907.

In American Canyon, the Nevada Almaden mine is worked for gold and cinnabar by hydraulicking. The ore occurs in a bluish limestone. A plant will probably be erected in 1908. No production resulted for 1907.

Thirty-five miles south of Lovelock, in the Humboldt Range, the Nevada United Mining Company has an exploration tunnel of 1,356 feet, which is to be extended to strike the main copper vein. Already a good strike of first-class zinc ore has been reported on this property. The year 1908 may put this mine on the producing list. The Mines Development Company is another new company under the same management. Several antimony properties in the Humboldt Range shipped ore during 1907.

Golconda and Gold Run districts.—Golconda, a station on the Southern Pacific Company's overland route, known for its hot springs, is the site of the 150-ton concentrating mill of the Glasgow and Western copper mines, which are located 12 miles south at the town of Adelaide. The ore is a low-grade chalcopyrite and has long been a source of great trouble in concentration because the chalcopyrite and the gangue are of nearly the same specific gravity. By the new tube-mill process, based on the different water-absorbing power of gangue and mineral, the percentage of extraction has been raised to 63 per cent, a gain of 13 per cent over that from Wilfley tables and Frue vanners. This novel method is described in the Engineering and Mining Journal by Walter R. Ingalls.[a] The mines at Adelaide are developed by a 400-foot vertical shaft and numerous tunnels and drifts. The ore is hauled to the mill by the company's narrow-gage railroad. The ore is dumped from the cars on a steel conveyor, carried to Huntington mills, crushed to 20 mesh, and then run through the tube mill. The concentrates are shipped to Salt Lake City. The tailings are run into a sump pond, and will be treated at some future date. Other mines at Adelaide, but not producers in 1907, are the Gold Coin Mining Company and the Nevada Crown Mining Company.

Gold Run district is also contiguous to Golconda, and the returns of the Adelaide and Gold Run producers have been combined in this report under the Golconda district in order not to divulge individual production. The Nevada Central Mining Company, in Gold Run district, shipped silver-lead ore to Salt Lake City in 1907. The shaft is down 125 feet on this mine, and 250 feet of tunnels have been run.

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[a] Ingalls, W. R., Eng. and Min. Jour., October 26, 1907.

The Gold Run Sunshine Mining Company expects to produce in 1908. The Florence group is equipped with a hoist. The Golconda Gold Ledge Company, a new strike at the close of the year 1907, plans the erection of a mill during 1908.

Humboldt House district.—Considerable silver-lead and silver-copper ore was shipped from this district in 1907. The Imaly Gold Mining Company, the Nevada Superior Mines Company, the Utah Development Company, and the Fifty-six Copper mine shipped to Salt Lake City or Ogden. The Antelope Spring Mining Company and the U. S. Gold and Copper Company did some development work, but shipped no ore.

Mills City district.—The Sheba Gold and Silver Mining Company again entered the list of shippers in 1907 with several cars of copper-lead-zinc ore, containing both gold and silver. The Michigan-Nevada Mining Company placed considerable shipping ore on the dump. The mine has a 200-foot shaft, with gasoline hoist.

Chafey district.—This new camp near Dun Glen, south of Winnemucca and east of Mills City, began life about June, 1908. Since that time considerable ore has been shipped by lessees and a 30-ton mill has been in operation. The ore is from the Mayflower mine.

Unionville district.—This old camp in the Humboldt Range, east of Lovelocks, made no production in 1907. Considerable work was done on the Arizona and Wheeler claims, but no ore was milled in the 2-stamp mill on the property. New capital has come into the camp, and some activity may be expected for 1908.

Seven Troughs district.—From Lovelocks, Humboldt County, Nev., it is but 30 miles west to the extensive Seven Troughs district. The country has long been known as a cattle range, and the center of the district is situated at the Seven Water Troughs, now the town of Seven Troughs. The mineral zone has already been shown to be continuous for 12 miles in length and 2 miles in width, and indeed claims have been staked for 24 miles farther north to the town of Rosebud, another new camp of promise.

There are 4 towns in the Seven Troughs district: Vernon, on the extreme south end; Farrell, on the north, 12 miles distant; Mazuma, 4 miles north of Vernon, at the mouth of the Seven Troughs Canyon; and Seven Troughs, 1 mile from Mazuma, at the head of the Seven Troughs Canyon. The 4 towns all sprang up within the year 1907, the town of Vernon being in its infancy during the whole of the year 1906. The first claims in the district were located in the summer of 1905. The towns are well supplied with wood and water.

The chief rock exposed in the district is rhyolite, cut from north to south by dikes of basalt.

The ore is high grade and contains gold with very little silver, and is found on the contact between the rhyolite and the intrusive igneous dikes.

The development work has been extensive. In 1907, 10 shafts were 300 feet or more in depth and 15 were down 100 feet, while several are 500 feet or more in depth. Over 40 companies, with as many lessees, were in existence.

In January, 1908, the contract was awarded to the Nevada Engineering Works to put in a 10-stamp mill with concentrators on the property of the Seven Troughs Kindergarten Mining Company. This plant is equipped with electricity, and, with that of the Mazuma

Hills Mining Company, has been producing bullion since the spring of 1908. Cyanide plants are to be installed at an early date.

The producers of the camp in 1907 were the Mazuma Hills Mining Company, the Seven Troughs Kindergarten, and the Seven Troughs Mining Company (Fairview).

In the fall of 1907 Messrs. Sims and Crumpacker, of Lovelocks, compiled a complete list of the incorporated companies and lessees, with estimated amounts of work done. The July Monthly Bulletin of the Seven Troughs Mining Stock Exchange differed slightly in the enumeration of companies, in that there were several new companies listed.

Some of the more active properties are enumerated as follows: Big Dipper Mining Company; Crumpacker, Piper, and Lipps, 3 claims, 250-foot shaft, 230 feet of tunnels, actively developed; Delaware Mining Company, 4 claims, 285-foot shaft and 263-foot drift, was worked by company and lessees; Fine Gold Mining Company, 8 claims, 235-foot shaft, 65-foot drift, 510-foot tunnel, was worked continuously by lessees; Gold King Mining and Milling Company, 9 claims, 90-foot shaft, worked continuously by company; Mae Mining Company, 4 claims, worked by company; Mazuma Hills Mining Company, 3 claims, 400-foot shaft and 955 feet of tunnels, was worked continuously by company and lessees and ore shipped to Salt Lake City in 1907, and a 10-stamp mill erected in 1908; Mazuma Hills Extension Mining Company, 3 claims, 230-foot shaft, worked by lessees; Seven Troughs Mining Company (Fairview and 12 other claims), 690-foot shaft on Fairview, 770 feet of drifts, worked continuously by the company and ore shipped in 1907, a mill planned exclusively for ore from this property, the shaft to be sunk to 1,000 feet in depth; Seven Troughs Buckhorn Mining Company, 5 claims, 435-foot shaft, 164 feet of drift, worked by the company; Seven Troughs Cleghorn, 5 claims, 375-foot shaft, 225 feet of drifts, worked continuously by company and lessees; Seven Troughs Consolidated, 4 claims, 180-foot shaft, 160 feet of drifts, 190 feet of tunnels, worked by the company and lessees; Seven Troughs Daisy, 4 claims, 150-foot shaft, worked by lessees; Seven Troughs Dingee, 1 claim, 120-foot shaft, and 160 feet of drifts, worked by lessees; Seven Troughs Eclipse, 6 claims, 260-foot shaft on Eclipse claim and 500-foot shaft on Syndicate claim, worked by company and lessees; Seven Troughs Gold Ledge, 2 claims, worked by company; Seven Troughs Golden Treasure, 2 claims, 65-foot shaft, and 200 feet of tunnel, suspended work for a time at close of 1907; Seven Troughs Humboldt, 5 claims, worked; Seven Troughs Kindergarten, 5 claims, 100-foot shaft, 600 feet of drifts, worked continuously by company and shipments made in 1907, and in the spring of 1908 a 10-stamp mill erected and bullion turned out regularly; Seven Troughs Knickerbocker, 4 claims, worked continuously by lessees; Seven Troughs Royal, worked by the company; Seven Troughs Signal Peak, 6 claims, 165-foot shaft, 145 feet of drifts, and 400 feet of tunnels, worked by the company; Seven Troughs Therien, 3 claims, 460-foot shaft, worked by lessees; Seven Troughs Tomboy, 7 claims, worked by the company; Vernon Nevada, 5 claims, 65-foot shaft, worked by lessees; Vernon Consolidated, 5 claims, worked by lessees by 60-foot shaft.

Much of the work is done by lessees, among whom there are abou 13 incorporated companies. Many are, of course, individuals o temporary associations of such.

Winnemucca district.—The Golden Eagle Mining Company, with a concentrating mill and cyanide plant, operated for a brief time in 1907. The Inter-Mountain Metal Company is equipped with a double compartment shaft and is down 250 feet.

Rosebud district.—At Winnemucca the Western Pacific leaves the general Southern Pacific line and strikes directly west, giving the camp of Rosebud much better transportation facilities. The camp at present is confined to quartz mining. No production was reported in 1907. A placer property was developed in 1908. Lessees on the Dreamland claim shipped during the summer of 1908. Other prospective shippers are the Brown Palace, Durango Girl, Sawtooth, Galena King, and the White Alps companies. At Rabbit Hole, near Rosebud, the Placerotis Gold Mining Company installed a plant for hydraulic mining in April, 1908.

Ashdown district.—The prospects of the region north and west of Winnemucca seem better with the coming of the railroad. Ashdown, over 125 miles from the railroad, has struggled for a long time with transportation troubles. The Pine Forest Mountains, however, have shown some promising prospects. Wood and water are reported plentiful. A lease has been let on a prospect 10 miles south of Ashdown, where some rich gold ore is reported. The Pine Forest Mines at Ashdown, with a 5-foot Huntington plate-amalgamation mill with no concentrators, made no production from the 15 claims of the company, but increased the development work to 4,500 feet in 6 tunnels. The company was a producer in 1906. The Nevada King Mining Company, a producer in 1906, did not run the mill in 1907.

Paradise Valley and Rebel Creek.—Some desultory development work was done in these camps, which lie northeast of Winnemucca, in the Cottonwood Range. The Manitou Mining Company, near Rebel Creek, is erecting a mill in 1908.

Goldbanks district.—Goldbanks, a new camp in 1907, is 40 miles south of Winnemucca and 100 miles north and east of Wonder. The main ore body, on a low-lying point of the East Range, lies in the flats of Grass Valley. The claims were worked in 1907 by lessees, who had to go down 50 feet before crosscutting. There were probably 40 or 50 lessees at work in November, 1907. Several new leases were taken on the principal property in August, 1908. There was no production in 1907.

The ore is found in a quartz-porphyry, associated with iron pyrites, and is reported to average $15 in gold and $2 silver and over. If the experience of the camp of Kennedy, 25 miles south on the same range, can be taken for anything, the future will depend on the installation of a concentrating mill.

Kennedy district.—Kennedy, an old camp about 75 miles south of Winnemucca and about 50 northeast of Lovelocks, was inactive in 1907. The Boulaska and Klondike, on which property there is a 20-stamp plate-amalgamation mill and a complete cyanide plant, was idle and the mill was closed during the year. Some work was done on the Fourth of July mine.

LANDER COUNTY.

Lander County in 1907 shared in the general activity of Nevada, and the total precious-metal production was valued at $342,068, as compared with $74,976 in 1906, a decided increase of $267,092. From 4,463 tons of ore, much of which was lead, copper, or copper-lead, Lander County produced 4,211.38 fine ounces of gold, valued at $87,057; silver to the value of $94,733, or 143,535 fine ounces; 615,544 pounds of copper, valued at $123,109; and 701,312 pounds of lead, valued at $37,169. This increase places the county at the head of the copper-producing counties, third in the production of lead, and fifth in silver. The copper came from the Copper Canyon and Copper Basin mines of the Glasgow and Western Company, in the Copper Basin district, from the Lander Mining and Milling Company at Lander, and from the Little Gem mine of the Reliance Mining and Milling Company at Tenabo. The lead was from the Utah Independence mine at Tenabo, the Lander Mining and Milling Company at Lander, the Gray Eagle at Bullion, and the Giant Mining and Milling Company at Copper Basin.

Metallic production of Lander County, Nev., in 1906 and 1907.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value
	Fine ounces.		*Fine ounces.*		*Pounds.*	
1906	538.27	$11,127	86,564	$57,998	3,404	$657
1907	4,211.38	87,057	143,535	94,733	615,544	123,109
Increase (+) or decrease (−)	+3,673.11	+75,930	+56,971	+36,735	+612,140	+122,452

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1906	90,506	$5,158	590	$36	$74,976
1907	701,312	37,169	....	....	342,068
Increase (+) or decrease (−)	+610,806	+32,011	−590	−36	+267,092

Austin district.—This old camp had a small output in 1907 from the property of the Austin Goldfield Mining Company, in New York Canyon, and from the Double H mine, both of which were shippers. The Austin Hannapah Mining Company, a producer in 1906, was taken over by the Austin Manhattan Consolidated Mining Company. No production was reported in 1907, but in June, 1908, the new company commenced retimbering the 600-foot shaft of the old Union mine. The operations of this company are expected to accomplish the rejuvenation of the town of Austin and a renewal of production from the old mines.

Skookum and Gweenah districts.—These 2 new districts, Skookum, 8 miles north of Austin, and Gweenah, 2 miles farther north, are camps of the spring of 1908. The Lemaire group, under lease to the Gweenah Consolidated Leasing Company and the Watt Mining

Company, are 2 of the new companies in active operation. It is proposed to build a power plant on Big Creek, 12 miles above Austin on Reese River, to supply power and light to Austin and the new camps.

Bullion district.—This district, which in this report includes the mines at Bullion, Lander, and Tenabo, had an output valued at $256,827. Of this, $85,027 was in gold, $70,687 was in silver, $65,121 (325,604 pounds) was in copper, and $35,992 (679,102 pounds) was in lead. The producers were the Gray Eagle mine, which shipped considerable lead-silver ore; the Bullion Hill Mining Company, the Lander Mining and Milling Company, at Lander, which is developed by an incline shaft 150 feet deep and 300 feet of drifts, and carries values in silver, copper, and lead, with a very small amount of gold; the Gold Quartz Mining Company, with a vertical shaft of 307 feet and a tunnel of 380 feet, with values principally in gold; the Little Gem mine of the Reliance Mining and Milling Company, with incline shaft of 450 feet, with values in gold, silver, and copper; and the Utah Independence Company, with an incline shaft of 200 feet, worked by the company and 10 lessees, with a vein of 6 to 18 inches of silver-lead ore—the last 3 being all at Tenabo.

Other properties in the district are the Widow mine, of the Reliance Mining and Milling Company, which is down to the 100-foot level and reports ore containing gold, copper, and silver, none of which was shipped in 1907; the Phœnix mine, down 230 feet, ore from which was sacked in 1907 but not shipped; the Monterey Mining Company; and the Rough and Ready mine of the Tenabo Mining and Townsite Company.

Copper Basin or Galena district.—The Copper Canyon and Copper Basin mines of the Glasgow and Western Exploration Company are at this point. The shaft is 500 feet deep. Considerable copper ore was shipped to Utah smelters from these mines in 1907. The Giant Mining and Milling Company, with a vertical shaft of 100 feet, shipped ore to Murray, Utah. The claims of the Pedro Gold Mining and Milling Company have been sold to Langley, Trimble & Co., of Tonopah.

Other properties in and around Battle Mountain and Copper Basin are the Lucky Strike, owned by Keith & Kearns, of Salt Lake, and a shipper of silver-lead ore early in 1908; the El Dorado Mining Company, on Willow Creek; the Golden Era, located 8 miles west of Battle Mountain; the Cumberland mine, equipped with a 10-stamp mill and a shipper in the first part of 1908; the Nevada Copper Butte Mining Company, located in Trenton Canyon, not a producer in 1907; the Franklin mine, 4 miles southwest of Battle Mountain, and a shipper in 1908; the Buena Vista group of the E. L. Labadie Company; and the Copper Basin Mining and Milling Company, under development for two years, and down 200 feet, with a tunnel 300 feet long.

LINCOLN COUNTY.

Lincoln County, with a production valued at over $1,000,000, continues to hold third place in rank among the counties of the State, though the total yield in 1907 fell off $362,182 in value, as compared with that of 1906.

Metallic production of Lincoln County, Nev., in 1906 and 1907.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
1906	54,561.97	$1,127,896	73,899	$49,512	521,043	$100,560
1907	44,977.87	929,775	58,259	38,451	244,179	48,836
Decrease	9,584.10	198,121	15,640	11,061	276,864	51,724

Year.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds*		
1906	918,830	$52,373	2,885,246	$176,000	$1,506,341
1907	290,766	15,411	1,892,984	111,686	1,144,159
Decrease	628,064	36,962	992,262	64,314	362,182

The falling off is due to reduced production from the big companies of the county—the Bamberger Delamar Mining Company, at Delamar; the Bristol Consolidated Copper Company, at Pioche; the Potosi Zinc Company, at Sandy; and to a small decrease from the combined companies at Searchlight.

The county, first in number of tons sold or treated in 1906, was second to Nye County in 1907, and Esmeralda County made a close third in this particular. The Bamberger Delamar Mining Company, which held first place in the State for the number of tons treated, gave way to the Tonopah Mining Company in 1907.

Bunkerville district (or Copper King).—The Nevada Copper, Platinum, and Nickel Company at this place did some development work in 1907. The ore is reported to occur in diorite or diabase in crystalline schists and, according to reliable statements, contain the three metals mentioned.

Caliente district.—The Elkton Gold Silver Mining Company shipped a carload of silver-lead ore to Utah smelters in 1907. The Advance Mining Company shipped early in 1908. The Josephine Gold Mining Company sunk their shaft to 90 feet. The Panaca mine was down 50 feet. Several other prospects were opened up during the year.

Crescent district.—In this camp, situated near the California line, in the southern part of the county, at least 7 incorporated companies have carried on development at one time or other during the year 1907. There were only 2 producers, the Nippeno Mining Company and the Old Crescent Mining Company. Both shipped ore to Utah, the returns giving values in gold, silver, and lead. The Nippeno Mining Company is developed by an incline shaft 535 feet deep, with drifts running from the shaft at every 100 feet. The company carried on development throughout the year. The Old Crescent Mining Company is down 60 feet, and is also developed by a 150-foot tunnel with a crosscut of 50 feet.

The Lucky Dutchman Mining Company carried on development throughout the year. The Big Tiger Gold Mining Company has sunk 2 shafts. 1 incline shaft 103 feet deep on the foot wall, and 2-compartment vertical shaft on the vein 250 feet deep, with 800 feet of crosscuts and drifts. The company is equipped with air compresso gasoline hoist, and pump. Development was carried on for part of the year 1907. The Ajax Bullfrog Mining Company ceased operations in November. Some development work was done on the Sta and White Duke claims of the R. and L. Mining Company. Th Wyoming Nevada Mining Company and Searchlight Gold Extensio Company closed down all work in the fall of 1907.

Delamar district.—At this point is the Bamberger Delamar Gol Mining Company, one of the largest producers in the State and surpassed in gold production by only 3 companies, at Goldfield an Tonopah. The mine is only 600 feet deep, but has 35 miles of tunnels All the ore is treated in a 400-ton cyanide mill by crushing in solution of cyanide with plate amalgamation and cyaniding of the sands and slimes. There are no other producers at this place, but some prospecting is carried on.

Eldorado Canyon district.—This district, east of Searchlight and situated near the Colorado River, was the scene of considerable development in 1907, but the value of the total production from 4 companies was under $10,000. Freight charges are so high that only ore valued at or above $65 can be shipped at a profit. Considerable lower-grade ore is on the dumps of the camp, and on the completion in September, 1908, of the 150-ton gas smelter by the Santa Barbara Searchlight Mining Company the production should advance materially.

In 1907 the Fortuna Gold Mining Company shipped ore to the Arizona Mexican Mining and Smelting Company, at Needles, Cal. The Fortuna Company has 2 shafts of 240 feet and 265 feet and about 400 feet of drifts and crosscuts. The Jumper (or Mizpah) mine shipped a small lot of oxide ore in 1907. In June, 1907, the mine changed hands, and a gasoline engine and hoist were installed. The Techaticup, first located in 1861 and now combined with 11 other patented claims and 6 unpatented claims under the name of the Wharton Gold Mines, was reopened in 1907, and 150 tons of ore were milled at the company's 25-stamp mill on the Colorado River, 6 miles from the mine. A shipment of crude ore was also sent to Utah smelters. The ore is stated to have been mined from a winze, 250 feet below the 200-foot level. The Santa Barbara Searchlight Mining Company made one shipment and reported 3,000 tons of ore on the dump, which is said to average $40 per ton in silver and $3 in gold per ton. The company is building a 150-ton gas smelter for their own ores and custom ores. This plant is to be completed in September, 1908. The Eldorado Nevada Mining Company has installed a 25-horsepower engine. The Capital Mines Company expects to produce in 1908.

The geology and mines of this district have been described by F. L. Ransome.[a]

Fay district.—The B. and C. group sacked considerable high-grade ore for shipment, and made one small shipment in 1907. The Horseshoe Gold Mining Company shipped some cyanide cement from a clean up of zinc boxes. On the Fawn group some good ore was struck in 1907, but none was shipped. The Newport Nevada Mining Company suspended all operations in 1907 pending reorganization. The mine has a vertical shaft of 200 feet and tunnels and drifts aggregating 2,000 fet. On the property is a 30-ton Chilean mill, equipped for plate amalgamation and with a cyanide plant. The cyanide is used in crushing and a stronger solution in leaching. The Deer Lodge Gold Mining and Milling Company were driving a tunnel of 1,400 feet to cut their lode.

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[a] Bull. U. S. Geol. Survey No. 303, 1907.

Patterson district (Geyser P. O.)—Some work was done on the properties of the Santa Marta Mining Company, consisting of 8 claims.

Gold Butte district.—Development work only was performed in this district. Mine operators answering the Survey's requests for production were the Crown Mining and Milling Company, the Kimberly Nevada Mining Company, the Nevada Gold Butte Mines Company, and the Southern Nevada Copper Company.

Lyons district.—This district is situated in a low desert range near the California line on the San Pedro road. The Lucy Gray Mining Company, a new company in 1907, may produce in 1908. The deposit is a gold-bearing vein in granite.

Other districts.—The Las Vegas Placer Mining Company shipped a small lot of copper-zinc ore to Murray, Utah, for the Copper Chief group. The operators of the Murphy mine also made a small shipment. The Castle Bar Dredging Company and the Gum Tree Dredging Company have ground in Boulder Canyon near the Colorado River which is said to be suitable for dredging. The Las Vegas Placer Mining Company also holds some placer ground.

Pioche district (including Ely and Jack Rabbit sections).—In this district the shippers in 1907 were the Boston and Pioche Mining Company, the Bristol Consolidated Mines and Smelting Company, the California-Nevada Copper Company, the Day mine of the Nevada-Utah Mines and Smelting Corporation, and the Poorman mine.

The central properties at Pioche, including the Raymond and Ely and the Meadow Valley vein and a part of the Yuba dike, are now held by the Nevada-Utah Mines and Smelters Corporation. The shafts are 1,500 feet in depth, but little work has been done below the water level, which is found at a depth of 1,200 feet. The company expects to reopen these mines, but has at the present no production from them. Adjoining on the east, the Boston and Pioche Company hold several claims on the Yuba dike, where they are now developing. The shaft is 400 feet deep on the incline, and some rich silver-lead sulphide ore has been shipped. On the west of Pioche, the Ohio-Kentucky Company is developing the Susan Duster mine with a 400-foot shaft, and has exposed a large body of mixed sulphide ore. Two miles west of Pioche, in the foothills of the range, the Prince Consolidated Company is developing a large body of oxidized lead-silver ore with much manganese. The shaft is 400 feet deep on the incline.

The lead-silver ores of the Ely mining district at Pioche occur in fissures in Ordovician quartzite or in the " Yuba " dike of quartz porphyry. In part they also form replacement ore bodies in the calcareous shale overlying this quartzite. The mineralization is closely connected with a long east and west porphyry dike coursing through the range.

The Jack Rabbit district is 14 miles northwest of Pioche, on the east side of the range. The Day mine, containing oxidized silver-lead ore, was operated by the Nevada-Utah Mining and Leasing Corporation, and the ore shipped to Pioche on a narrow-gage railroad. The shaft is 800 feet in depth and the ore occurs in limestone. On the west side of the same range is the Bristol Company's copper mine, from which much oxidized copper ore was shipped during the year. The ore body is contained in limestone. At the Highland district, 8 miles northwest of Pioche, the Mendha mine was developed by a shaft 700 feet on incline and 300 feet on the vertical, and it is expected to be a shipper in 1908. The geological formation is similar to that of Pioche. The ore is partly oxidized lead ore. The mine is said to have produced ore valued at $1,000,000 about sixteen years ago.

Searchlight district.—The Blossom Mining Company shipped its bullion to the San Francisco mint. The Cyrus Noble Mining Company did not run its 10-stamp mill, but sold some accumulated tailings. The G. F. Colton Mines Company worked the Searchlight and New Year's Gift claims, which were both in the prospective stage in February, 1907. The development at the close of 1907 consisted of 2 incline shafts, one down 400 feet and the other 450 feet. The equipment consists of a 10-stamp plate-amalgamation mill, with no concentration. The greater part of the ore was treated at the mill, including 2,800 tons of old tailings, and several shipments of crude ore were made. The Quartette Mining Company, the largest producer in the district and one of the largest in the State, confined operations to the Golden Treasure claim of its property. The quantity of ore mined was considerably increased over that of 1906, and was treated in the company's 40-stamp plate-amalgamation mill, having a capacity of 160 tons in twenty-four hours, without concentration. About 200 tons of ore were shipped. The mine is developed by 2 shafts on the vein, 1 incline shaft at an angle of 50° to a depth of 1,000 feet on the incline, and 1 at the same angle 800 feet in depth. There are 9 levels, rather unevenly spaced. Values are principally in gold, with some silver, copper, and lead. The ore is generally oxidized, but a little chalcocite is occasionally found and some galena. Chrysocolla, cerussite, wulfenite (molybdate of lead), malachite, and azurite are some of the minerals found. The gold as a rule is not visible to the naked eye. The Boston group of the company has been prospected by an incline shaft of 300 feet and a vertical shaft of 400 feet. This mine was not worked in 1907. The Quartette Mining Company acquired the Rambler claims in 1907. The Searchlight Mining and Milling Company produced considerable bullion in its 10-stamp mill. The Blackhawk Consolidated Mining Company completed a 10-stamp mill, but closed down the mine shortly after. The Boulder Mining and Milling Company merely did development work. The mine has a vertical shaft of 270 feet and about 700 feet of crosscuts and drifts. The Cyrus Noble Extension did not work in 1907. The mine is down to 200 feet on a 50° incline. The Searchlight Copper-Gold Mining Company and the Searchlight Treasure have 100-foot incline shafts. The New York Searchlight Mining Company has a 240-foot vertical shaft.

The Searchlight-Parallel Gold Mining Company with a 500-foot shaft and 1,900 feet of drifts, made no production in 1907. The geology and mines of Searchlight have been described by F. L. Ransome.[a]

Yellow Pine district.—This district includes the towns of Goodsprings and Sandy, and is situated 30 miles southwest of Las Vegas in the Spring Range. It principally yields ores of copper, lead, and zinc in limestone, though the Nevada-Keystone and other mines are free milling and worked entirely for the gold. The "99" Copper Company shipped in January and February, 1907, a carload or two of silver-copper ore. The Yellowpine Mining Company, working the Bybee mine of the Rover group, 4 miles west of Goldsprings, and the Porter mine, 4 miles south of Goodsprings, shipped their copper and lead ores to Salt Lake City samplers and the zinc ore to Gas, Kans. The company has an incline shaft 200 feet deep and is installing a concentrating mill. S. E. Yount also shipped ore, carrying values in copper and in silver. The Lucky Strike Mining Company also sent out a carload of lead ore in 1907, and expects to ship more in 1908. The Nevada Keystone Mining Company produced gold bullion in 1907, as did the Southern Nevada Copper Company. The Potosi Zinc Company's production was small in 1907, owing to the stopping of all shipments in July. The company had about 25 men doing development work. The mine is worked by a main tunnel 700 feet in length, with drifts and crosscuts. The ore is shipped to the Empire Zinc Company at Iola and Gas, Kans. The Columbia mine of the Goodsprings Consolidated Mining and Smelting Company did not work in 1907, but expects to operate in 1908. The Utah Esmeralda Copper Mining Company was absorbed by the "99" Copper Company. The Nevada Copper Company did development work. The Hoosier mine is developed by 600 feet of tunnels, and some ore will probably be shipped in 1908. The Monte Cristo zinc mine was taken over by Los Angeles capital.

LYON COUNTY.

Lyon County fell off $127,641 in value of production in 1907 as compared with that of 1906. This loss was due entirely to the decreased production in the Yerington or Mason copper district. The Ramsey district came to the front at the close of 1907 and, with the Mason district, took on new life. An increase is looked for in 1908.

Dayton and Silver City districts.—The old Devils Gate and Chinatown district is contiguous to both Dayton and Silver City, and is only a few miles south of Virginia City. The largest producer is the Nevada Mining, Reduction and Power Company. The company owns 15 claims. Of these the Ida is developed by an incline shaft 300 feet deep and by 1,500 feet of drifts. The Haywood and Santiago are contiguous, and are worked as one mine by an adit 1,530 feet long. Other drifts and tunnels aggregate 6,000 feet. The reduction plant consists of one 18-stamp and one 20-stamp plate-amalgamation mill, with no concentrators. The tailings, which carry about 20 per cent of the value of the ore, are chloro-cyanided in two separate plant King's placers, also in this district, are worked by sluicing. Th Dazet mill made a small run in 1907, as did the Pollard mill. Th Buckeye Mining Company worked considerable ore in its cyanid plant. The Silver City Gold and Silver Mining Company has 1,50 feet of tunnels. This property was worked by lessees during 190 The ore was treated in a 4-foot Bryan mill. The Vivian mine was producer. The New York and Nevada Mining Company was a new producing company in 1907. Many small tributers worked in this camp in 1907. The South Comstock Consolidated Mines Company, a producer in 1906, was idle in 1907, and reverted to the original owner on January 1, 1908. The Oest Gold and Silver Mining Company, also a producer in 1906, yielded no ore in 1907. The Comet and Comet North Extension are expected to make a good showing in 1908. Mr. Roscoe Wheeler acquired an option on the Douglass tailings of 600,000 tons and is building a plant.

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[a] Bull. U. S. Geol. Survey No. 303, 1907.

Ramsey district.—One shipment is recorded from this camp in 1907, that of the Ramsey Comstock. No other company produced, though several mills were in course of construction, and the year 1908 will probably show a better result. The taking over of the Ramsey Comstock by Nixon and Wingfield of the Goldfield Consolidated, and the active development by that company in 1908 has aroused considerable activity in the camp.

Mason district.—The principal point of interest in this camp at Yerington was the taking over of the Ludwig Copper Company (the principal producer in 1906) by the Nevada Douglas Copper Company. The Ludwig mine continued to produce ore under the new management, and some ore was also shipped from the Douglas mine. The Ludwig is developed by a vertical shaft 400 feet deep and with a 45-degree incline from the bottom of the shaft 250 feet deep. The Douglas mine has several vertical shafts from 40 feet to 200 feet deep and a tunnel 650 long. The ore shipped in 1907 was high-grade carbonate ore. A small lot of lead-silver ore was shipped from the Emerson mine. The mine of the Western Nevada Copper Company has now a tunnel 300 feet long and another 1,000 feet long. Development work was performed by the Mason Valley Copper Company, the McConnell Mining Company, the Nevada Bonanza Copper Company, the Yerington Consolidated Copper Company, and the Yerington Ironsides Copper Mining Company. The Yerington Copper Company is down 345 feet. The Yerington Malachite Copper Company started a 3-compartment shaft and sunk 142 feet in 1907. The mine is equipped with compressor and hoisting plant.

NYE COUNTY.

Metallic production of Nye County, Nev., in 1906 and 1907.

Year.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
1906	71,824.73	$1,484,749	5,739,852	$3,845,701
1907	74,855.86	1,547,408	5,557,535	3,667,973
Increase (+) or decrease (−)	+3,031.13	+62,659	−182,317	−177,728

Year.	Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Valve.	
	Pounds.		*Pounds.*		
1906	....	....	16,508	$941	$5,331,391
1907	9,096	$1,819	274,346	14,540	5,231,740
Increase (+) or decrease (−)	+9,096	+1,819	+257,838	+13,599	−99,651

With the exception of Esmeralda, Nye is the most productive county in Nevada, including, as it does, the important silver-yielding camp of Tonopah, as well as several other districts of prominence. The districts in Nye County are Bellehelen, Berlin, Marble, Bullfrog, Goldyke, Golden, Round Mountain, Manhattan, Silver Bow, and Tonopah.

From the preceding table it may be seen that Nye County in 1907 yielded 74,855.86 fine ounces of gold, valued at $1,547,408, which is, in value, $62,659 more than the production in 1906. The silver amounted to 5,557,535 ounces, valued at $3,667,973, which is $177,728 less than the corresponding value in 1906. Both copper and lead outputs increased to a small extent. The total output of the county in 1907 was valued at $5,231,740, which is $99,651 less than in 1906.

In 1907 the county had 50 productive mines, of which 41 were deep, including 23 gold, 16 silver, 1 lead, and 1 copper-lead mine. Of the 9 placer mines, 5 were hydraulic and 4 "dry washers." In 1906 there were 34 productive mines, of which 4 were dry washers and 30 deep mines. The 41 deep mines yielded 242,168 short tons of ore, which, with the exception of 240 tons of lead ores and 251 tons of copper-lead ores, were dry or siliceous ore. This was almost double the ore output of any other county in the State. Of this total ore yield, 214,608 tons came from Tonopah, the next district in order of ore production being Round Mountain district. The ore milled in the county in 1907 amounted to 186,552 tons, carrying values of $733,956 in gold and $1,325,606 in silver. From this ore the concentrates produced amounted to 1,511 tons, carrying values of $128,409 in gold and $659,030 in silver. The crude ore shipped to smelters was 55,606 tons, yielding values of $635,523 in gold and $1,682,291 in silver. A few tons (10) of old tailings were treated.

The gold yield from the placers of the county was 2,395.53 fine ounces, valued at $49,520; and the silver from the same source amounted to 1,585 ounces, valued commercially at $1,046. These placers are at Round Mountain and Manhattan.

Bellehelen district.—In this district, the Gazabo, the Original Horseshoe Mining Company (worked mainly by lessees) and the Paradise Lost mine were producers, but the combined output was not large. The Lawrence Consolidated Company, the Tomahawk Mining Company, the Columbus-Nevada Mining Company, and the Scioto-Nevada Mining Company reported development work. To ship ore from the camp costs about $60 per ton, not including mining, so that but little production can be expected until a railroad or reduction works are constructed.

Berlin and Marble districts.—At Berlin the Nevada Company owns and operates the Berlin and Richmond mines, producing gold, silver, some copper, and a little lead. The property is developed by a shaft 750 feet deep on the incline. The company has a 30-stamp mill with plate amalgamation and 8 Frue vanners. In Marble district the Lodi Mines Company is mining smelting ore which yields gold, silver, and lead. The incline shaft is 560 feet deep, and the tunnel 300 feet long.

Bullfrog district.—This is one of the important districts of Nevada which, with increased development, is expected to come more rapidly to the front. In 1907 the camp yielded 9,050 tons of ore, worth $132,428 in gold, $74,991 in silver, $112 in copper, and $7 in lead, a total of $207,538. The largest producer was the Montgomery Shoshone Mining Company. The district lies 60 miles southeast of Goldfield, and the principal towns are Rhyolite and Beatty. The district has railroad connection with main lines. The first mines were opened in the autumn of 1904, and there are many locators. The district has been described by F. L. Ransome.[a]

The Bullfrog Gold Bar Mining Company completed a 10-stamp plate-amalgamation mill in 1908. The crude ore was previously sold in Salt Lake City. The Bullfrog Skookum Mining Company has mined silver ore, carrying a little gold, copper, and lead. The Bullfrog National Mining Company and the Bullfrog Reduction and Water Company are both small shippers, as is the Gibraltar Mines Syndicate. The Homestake King Consolidated Mining Company shipped a small quantity of ore for metallurgical tests and subsequently erected a 25-stamp mill equipped for plate amalgamation and cyaniding. The mine is developed by a shaft 500 feet deep on the incline. The Original Bullfrog Mining Company made a small production. The Tramp Consolidated Mining Company (including the Tramp, Eclipse, and Dennis claims) has ores of grade reported too low for shipment and smelter treatment. The Montgomery Shoshone Mining Company, the principal property in the camp, is developed by a 640-foot vertical shaft. The company worked the Montgomery Shoshone and the Shoshone Polaris mines. The ores were worked by the Bullfrog Reduction and Water Company at Rhyolite, and the American Smelting and Refining Company at Murray, Utah, two-thirds of the ores being milled.

Goldyke (or Atwood) *district.*—In this district most of the mines were idle in 1907, but yield was made by the Goldyke Reef Mining

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[a] Bull. U. S. Geol. Survey No. 303, 1907.

Company and the Pactolus Mining Company. What ore came from the latter was reduced to determine the nature of the necessary reduction process. At the Atwood Gold King Mining Company's property active work was begun in 1908. The Sierra Vista Mining Company is under lease and promised production in 1908. This camp has become much more active in 1908 than it was during 1907.

Golden district.—The total production of this district in 1907 was not large. Three mines were producing. The Cirac Mining Company has one vertical 150-foot shaft and about 850 feet of drifts. The ore came from that part of the Cirac company's property under lease to the Rogers Mining and Milling Company. The Orizaba Mining Company has a 120-foot incline shaft and about 450 feet in drifts. The ore taken from the Imperial Cirac mine was by lessees. The United Verde Gold Mining Company was a producer in 1906, but not in 1907.

Round Mountain district.—The total output of this 'district in 1907 was valued at $122,261 from deep mines, and $49,310 from placers, a total of $171,571. The deep mines produced 15,059 short tons of gold and silver ore. The Round Mountain Mining Company was the principal producer, having yielded 14,000 tons of the ore from the district. The mill equipment has a capacity of 85 tons a day, and this was increased in 1908. A great deal of development work was accomplished in 1907 and it is reported that the ore reserves were materially added to. The company has, in 1908, purchased the Great Western Mining Company's property, adjoining its holdings on the west. The ore from the Antelope mine, obtained by lessees, was treated in local mills. The Round Mountain Daisy Mining Company made quite a large production (through lessees), the ore being shipped to local custom mills. The company is, in 1908, building a 100-ton mill. The Round Mountain Antelope Mining Company was operated by five sets of lessees, and the ore treated at local mills.

The placers worked in this district are thought to be the results of erosion from the gold-bearing ledges above the deposits and are all worked by hydraulic process, though some dry washing has also been done. The Round Mountain Hydraulic Gold Mining Company owns or leases the principal placers. New water-pipe connections have been made with both Jefferson and Slaughterhouse canyons, so that there is now a good supply of water. Most of the companies owning the placers operate quartz mines, but their top ground is hydraulicked by themselves or by leasing companies. Working this ground by hydraulic process has resulted in the opening up of several "blind" veins.

Among the companies at Round Mountain which are in a position to make some yield in 1908 are the Combination Mining Company, the Round Mountain Alleghany Mining Company, the Evening Fraction Company, the Round Mountain Red Top Mining Company, and the Round Mountain Fairview Company. This last company made some production in 1907 from leases, and has purchased a mill. The Round Mountain Sphinx Company has a 5-foot Huntington mill. The shaft is vertical and 210 feet deep, and there are 2,500 feet of drifts. The mine became productive in 1908. The Gold Hill Consolidated Mining Company, organized in 1907, expects to produce in

1908 as soon as the mill is completed. The Royal Hawaiian Extension Mining Company is putting in a hydraulic pipe line to bring water on its ground.

Johnnie district.—No returns of production were made from this district in 1907, but considerable development work was done. The Johnnie Consolidated Mining Company completed a 16-stamp Nissen mill, with amalgamation and cyanide plant, in January, 1908. The 45-degree incline shaft is 800 feet deep, and levels are cut at every 100 feet. The total drifts aggregate 7,000 feet in length. The Crown Point Globe Mining Company will be a producer in 1908. The shaft is 210 feet deep, and there are about 1,000 feet of drifts.

Manhattan district.—The results accomplished in Manhattan district in 1907 were disappointing. In fact, the yield in 1907, which was valued at $33,622, was less than that in 1906. The properties produced considerable ore, but it was added to the amounts stored at the respective mines where it has been accumulating for several years past, awaiting reduction works. The mills were only in operation during the last six weeks of 1907. There are now 4 mills in the camp, each with a daily capacity of about 30 tons. A number of lessees are working the mines, and some dry-washing is going on in the placer claims. Mining in 1907 was inactive, largely owing to lack of money to carry on development. This money must be raised and the mines sunk deeper before the output of the camp becomes noteworthy. Since the close of the year more activity has been shown and the camp is likely to do better in 1908 than in 1907.

The largest producer in 1907 was the Manhattan Consolidated Mines Company which is developed by a 220-foot shaft and a 580-foot tunnel. It has a 10-stamp plate-amalgamation mill and cyanide plant, but did not begin milling until late in the year. The Manhattan Dexter Mining Company had its ore mined by lessees and this was shipped to smelters. It was a small producer, but it owns or controls a large number of properties. Financial disturbances prevented very active work during the year. The Manhattan Combination Mining Company made a small output, as did a number of claims worked in a small way.

Among the many deep mines which were not productive in 1907 was the April Fool of the Seyler-Humphrey Mining Company. The Stray Dog, the Jumping Jack, and the Indian Camp mines were operated by lessees in 1908. The Manhattan Giant Mining Company has a 200-foot shaft with 3 levels, but was closed owing to lack of funds. The Big Chief Mining Company will probably be a producer. The Manhattan Thanksgiving Mining Company reported considerable ore on the dump waiting opportunity for milling. The Otero is in the same position.

Some placer gold was obtained by dry washing, most of it from a lease on the ground of the Little Grey Mining Company.

Silver Bow district.—This district yielded a small production of gold and silver in 1907. The Catlin Silver Bow Mining Company contributed the largest share, but some output was also reported by the Nevada Silver Bow Mining Company and the Silver Bow Belle Mining Company. In this camp only high-grade gold ores can be shipped profitably under present conditions.

TONOPAH DISTRICT.

Production of Tonopah district, Nye County, Nev., in 1906 and 1907.

Year.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
1906	63,113.75	$1,304,677	5,697,928	$3,817,612
1907	57,258.00	1,183,628	5,370,891	3,544,788
Increase (+) or decrease (−)	−5,855.75	−121,049	−327,037	−272,824

Year.	Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1906					$5,122,289
1907	5,939	$1,188	195,508	$10,362	4,739,966
Increase (+) or decrease (−)	+5,939	+1,188	+195,508	+10,362	−382,323

From the above table it appears that there was a falling off in 1907, as compared with 1906, in Tonopah, of $121,049 in gold and $272,824 in silver, while both the copper and lead values increased somewhat, so that the total reduction in value of output for the year was $382,323. Returns were received from 10 productive lode mines in the camp in 1907. These mines yielded 214,608 short tons of ore, the gold values in which were $1,183,628 and the silver values $3,544,788, aside from small amounts of copper and lead. The total gold and silver yield of the camp in 1907 was therefore valued at $4,728,416, which is $393,873 less in these two metals than the corresponding value was in 1906. This smaller yield is entirely due to materially reduced output of two of the prominent mines of the camp.

Of the 214,608 short tons of ore treated in the camp, 162,816 tons were treated at mills, yielding by amalgamation $495,436 in gold and $1,273,965 in silver, or a total value of $1,769,401, and an average value per ton of $10.87 in gold and silver. From this milling ore 1,451 tons of concentrates were produced, yielding $126,716 in gold and $655,703 in silver, a total value of $782,419, or an average value of $539.23 per ton, in gold and silver. The milling ores therefore yielded, both on plates and from concentrates, $622,152 in gold and $1,929,668 in silver, a total of $2,551,820 in gold and silver. This shows an average yield per ton of $3.82 in gold and $11.85 in silver, a total of $15.67 per ton in gold and silver.

In 1907 there were shipped to smelters from Tonopah 51,792 short tons of ore, valued at $561,476 in gold and $1,615,120 in silver, a total of $2,176,596, or an average per ton of $42.03 in gold and silver.

As the yield of the camp in 1907 was $1,183,628 in gold and $3,544,788 in silver, a total of $4,728,416, from the 214,608 tons of ore milled and smelted, the average value per ton of ores treated is seen to be $5.51 in gold and $16.52 in silver, an average value per ton in gold and silver of $22.03.

In 1906 the quantity of ore treated from Tonopah, all at smelters, was 106,491 short tons, yielding $35.85 in silver and $12.25 in gold per ton, an average value per ton in gold and silver of $48.10.

The tonnage in 1907 was about double that of the year 1906, having increased by 108,117 tons. The grade of the ore treated in 1907, however, was about half the value of that in 1906, or $22.03 per ton in 1907 as compared with $48.10 per ton in 1906.

Since milling has been introduced into the camp, in 1907, the lower grade ores are also utilized, which accounts for increased tonnage and decreased average values per ton. Moreover, during the period of financial stringency in 1907 some of the companies deemed it proper to draw upon the dumps of milling ore, thus avoiding mining expense, although a lower grade ore was treated.

By far the most productive property in Tonopah is the Tonopah Mining Company of Nevada, which is very fully developed and has a 100-stamp mill with concentrators and cyanide plant 15 miles from the mine, and which is fully described hereinafter. In the calendar year 1907 this company treated in gold and silver mills 117,295 tons of ore, and shipped to smelters 23,460 tons, a total of 140,755 tons. The concentrates sold or treated amounted to 856 tons. The gold obtained was valued at $677,912 and the silver at $1,991,141, a total of $2,669,053. The operations for the year show a decrease in cost of mining of $1.42 per dry ton of ore shipped and placed on dump. The mining cost per ton of ore shipped was $5.10; the mining cost per ton of ore shipped and placed on dump was $4.47, and the mining cost per ton of all ore and waste hoisted was $3.73. A comparison of results obtained at the new Desert mill for the year and the results which would have been obtained by shipping the same ore to smelters shows that the ore milled averaged in value $24.64 per ton, at a cost per dry ton of $10.54. The smelting cost per dry ton would have been $15.11 per ton. The net saving by milling the ores of $4.57 per ton amounted to about half the cost of the mill during the first year's operation.

During 1907 the Esmeralda Power Company was formed to take over the power plant at Millers and the transmission line to Tonopah. This company is owned 75 per cent by the Tonopah Mining Company and 25 per cent by the Tonopah Belmont Development Company. The Esmeralda Company assumed the contract with the Nevada-California Power Company and the distribution of power under that contract to the various companies mentioned therein. The addition of air-hammer rock drills to the mine equipment for stoping and raising has been of material benefit; two types are now in use, the "Waugh" and the "Murphy." They weigh 65 pounds fully equipped, are easily handled by one man, and strike about 1,500 blows per minute under an air pressure at the drill of about 85 pounds, with an average of 50 feet drilled per shift. These drills are reported to be more effective in stopes and raises in this ground than piston drills, which average 35 feet drilled per shift, with more air consumption, cost of maintenance of drills, and labor. As to development work on this property, the total number of feet of drifting, crosscutting, winzes, raises, and excavations to the end of February, 1908, was 25,322 feet of drifts; 13,177 feet of crosscuts; 5,911 feet of winzes and raises; 873 cubic yards of excavation; 3,228 feet of shafts; and 2,595 feet of lessees' shafts. As to milling operations, the 100-stamp mill was built to treat 400 tons of ore per day, but it has of late been handling an average of 450 tons per day. The average cost of milling—direct and indirect cost—for the year was $5.91 per ton, but late work has decreased this by $1.18 per ton.

The next important producer is the Tonopah Belmont Development Company. The Belmont 60-stamp mill of this property was started up on the last day of May, 1907, and is described elsewhere in this chapter. The mine is developed by a vertical shaft 1,128 feet deep, and the total development work in the mine amounts to 20,287 feet. The average reported value of the ore milled was $18.93 per ton, and the average cost of milling has been $7.82 per ton. The ore shipped to smelters yielded $31.82 per ton, on which $17.92 per ton was realized after paying all expenses.

The Jim Butler Tonopah Mining Company, which has a 500-foot vertical shaft, with 2 miles of workings from various shafts, now owns several continuous properties under one management. The Montana-Tonopah Mining Company is developed by a shaft 860 feet deep, with five main and several intermediate levels. The 40-stamp mill was put in operation in August, 1907, and the metallurgical results have been fully up to expectation. After running 2 months, the practice of crushing in cyanide solutions instead of in water, was introduced, with a marked saving in the consumption of cyanide. When milling was first commenced, the cost was $4.12 per ton, but later on this was reduced to $3.51 per ton. The following particulars of milling operations may be of interest: The cyanide used was a trifle over 2 pounds, the zinc dust used about ¾ pounds, and the lime used about 8.3 pounds per ton milled. The cyanide used in the mill water was about 0.0095 per cent (1.90 pounds per ton of a water). The consumption of water was about 40,000 gallons per day. The mill has regrinding and concentrating departments and a cyanide plant. The concentrates and cyanide precipitate are both sold to the Selby Smelting Company, San Francisco, Cal.

The Nevada Alpine Mining Company, consisting of the old O'Meara-Lynch properties, although in Tonopah district, is actually over the border line in Esmeralda County, and its output should not properly have been included with the Tonopah mines in Nye County. This was inadvertently done, however, and the tabular work in this chapter was all completed before it was realized that the output of this mine should have been recorded in another county. This accounts for the appearance in this report of some lead and copper attributed to Tonopah district which was really derived from Esmeralda County.

The Southern Klondike mine is one of the smaller producers of Tonopah, which has a shaft down 210 feet, but the ore shipped was virtually from the croppings. The Tonopah Extension Mining Company, quite a large producer, has a shaft 1,050 feet deep, with 6 levels east and west. The ore is shipped to smelters. The Tonopah Midway Mining Company, also a large producer, has a vertical shaft 800 feet deep, and its ores are sold to the Western Ore Purchasing Company. The West End Consolidated Mining Company, another good producer, has 3 shafts, respectively, 770 feet, 322 feet, and 770 feet deep.

Among the nonproducers at Tonopah, of which there are a number, the Baxter Springs Mining and Milling Company owns 5 claims upon which development is being carried on. The Little Tonopah Development Company has a shaft 900 feet deep, and development work was continued during 1907. The MacNamara Mining Company has a shaft 500 feet deep. The Millbrae Tonopah Mining Company, with a 265-foot shaft and a 325-foot tunnel, is continuing its tunnel to cut the lode. The Mizpah Extension Mining Company retimbered the 835-foot shaft and will sink deeper. The Great Western Mining Company has a shaft 508 feet deep and is well equipped, but has not reached sufficient depth to enter the vein zone.

The geology and mineral veins of Tonopah have been very fully described by J. E. Spurr,[a] so that it is not necessary to go into any details on those subjects in this chapter.

ORMSBY COUNTY.

No report was received in 1907 from any productive property in this county. The two towns of the county are Carson and Empire. At the last-named point the Comstock Mining and Milling Company has its Morgan plant. This cyanide plant treated several thousand tons of old tailings from the Consolidated Virginia mine at Virginia City, which production is allotted to Storey County. The California plant of this company in Storey County has been dismantled. The Bessemer Consolidated Mining Company, in Brunswick Canyon, is working hematite ore, running 68 per cent in iron. A carload was shipped to San Francisco for testing purposes. The ore is said to be free from sulphur and phosphorus, and there seems to be an unlimited supply.

STOREY COUNTY.

Metallic production of Storey County, Nev., in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Lead.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		
1906	15,855.68	$327,766	277,258	$185,763	....	....	....	....	$513,529
1907	12,320.63	254,690	162,791	107,442	2,717	$543	2,373	$126	362,801
Increase (+) or decrease (−)	−3,535.05	−73,076	−114,467	−78,321	+2,717	+543	+2,373	+126	−150,728

This county, for many years formerly the most productive in the State on account of the activities on the Comstock Lode, showed a total falling off in value of output in 1907 from that of 1906 of $150,728. Reduced output in both gold and silver was evident, and copper and lead appeared in the county record for the first time, though in a small way. In 1907 reports were received from 21 producing deep mines in the county and from 26 nonproducers. The total tonnage was 39,400 short tons for 1907, of which 39,369 tons was siliceous ore, the remainder being copper-lead ores. This siliceous ore yielded $246,381 in gold and $106,045 in silver, a total of $352,426. The 31 tons of copper-lead ores yielded $8,309 in gold and $1,397 in silver, a total of $9,706. These latter ores also yielded copper valued at $543 (2,717 pounds) and lead valued at $126 (2,373 pounds).

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[a] Prof. Paper U. S. Geol. Survey, No. 42, 1905.

Of the total ore, 18,731 tons were treated at gold and silver mills, yielding $120,966 in gold and $24,451 in silver. This same ore contained 315 tons of concentrates yielding $108,595 in gold and $63,537 in silver. The milling ore therefore yielded gold and silver valued at $317,549. There were also 20,324 tons of old tailings treated, the bullion from which is included in the figures for gold and silver derived from milling ore as given above. Of ores shipped to smelter, there were 345 tons containing $25,129 in gold and $19,454 in silver, a total of $44,583.

Among the Comstock producers at Gold Hill in 1907, the Alpha-Consolidated Mining Company made only a nominal yield. This mine is opened by a tunnel 2,400 feet long. The ore was treated in a 15-stamp custom mill by the lessee, and when the lease expired work was entirely suspended. The Overland Mining Company has an incline shaft 550 feet deep with several levels. This company has a 10-stamp plate-amalgamation mill, with regrinding pans. The percolation cyanide plant of 800 tons capacity per month is at Silver City. The tailings are flumed from the Overland mine to the cyanide plant. The Silver Hill Mining Company milled old tailings only, these being treated at McTigue's mill.

At Virginia City the Sierra Nevada Mining Company shipped only a few tons of concentrates, which contained some copper and lead. Operations are now being carried on through the Union shaft, in which the company owns a one-third interest. Interesting developments are now under way on this property. On the Chollar and Potosi ground, work is being done through the 2,000-foot tunnel by lessees, and some ore has also been taken from croppings. On the Sutro tunnel level a drift is being opened southerly from the Hale & Norcross connection in order to prospect the vein on this level. The Consolidated California and Virginia Mining Company treated upward of 9,000 tons of tailings and a small quantity of ore. This mine has a 2,500-foot vertical shaft. Since the close of 1907 the mine has again become an ore producer. The Hale & Norcross Mining Company, developed by a 1,600-foot vertical shaft and a 6,000-foot tunnel, had its ore milled by the Comstock Tunnel Company, at Sutro. The operations at this mine are now confined to work on the Sutro tunnel level. Jointly with the Chollar and Potosi companies, this company has installed a blower and a 15-inch air-pipe from the Mint shaft to the workings west of the south lateral of the Sutro tunnel. Some fair grade ore has been opened up, which was milled in 1908.

The Lady Bryan Mining Company only made a small output. The Ophir Mining Company, the largest producer on the Comstock, worked through the shaft of the Consolidated California and Virginia mine. In addition to the ore produced, about 7,000 tons of old tailings were treated. Good ore has been reported in this mine since the close of 1907.

Among the nonproducers it may be stated of the Yellow Jacket Gold and Silver Mining Company, that a 200-ton concentrating mill was built, being completed early in 1908. It has since been in successful operation on low grade ore from the mine, dumps, and surface workings. This property is dependent on the Belcher shaft for ventilation and for this reason has joined the other Gold Hill companies in keeping this shaft in repair. The Union Consolidated Mining Company is carrying on some prospecting through the Union shaft. As to the Gould and Curry mine preparations are being made for prospecting from the north lateral of the Sutro tunnel. In the Savage, operations have been confined to the Sutro tunnel level, and considerable low grade ore has been opened up in the last two years. Better facilities for transporting this ore through the tunnel are being provided. On the Imperial, during the last year the old Bowers shaft has been reequipped with electric machinery. All work on the Crown Point property is now being carried on through the Overman shaft, and an important drift is being driven northerly on the 1,400 level. The Belcher old shaft has been completely equipped with electrical machinery and is now in good condition for operation to the 850-level. At the Overman mine the shaft has been equipped with electrical machinery, and crude oil is used as fuel. Considerable work has been done and some low grade ore found on levels above the water.

In the Caledonia mine recent work has been extensive and of some importance. On 3 levels a vein has been followed about 2,500 feet to the southwest, and some fair assays obtained. Some surface work is going on in the Justice.

The great width of the Comstock lode requires an enormous amount of development on each level before it is thoroughly prospected. There was a great yield of ore from the Crown Point, Belcher, Yellow Jacket, Chollar, Hale & Norcross, and Consolidated California and Virginia mines (bonanzas) after they were supposed to be worked out. Those interested, for this and other reasons, think that there is not a level on the lode which has been so thoroughly prospected that there is not yet a chance of finding ore in it. The Combination shaft is one of the most important features in the rehabilitation of the Comstock. This shaft is 3,250 feet deep and will prove a valuable acquisition when connection has been made with the Ward shaft. It is impossible to operate any one of these hot mines without the very best facilities for ventilation, and this shaft, in combination with the Ward, affords an easy solution of the problem. The Combination shaft was repaired to the 1,600 level about three years ago, and during the spring of 1908 the Sutro tunnel connecting drift and the 1,600 station have been repaired. The Comstock Pumping Association is carrying on its drainage operations through the C. and C. shaft, where it has a fine pumping equipment. This association is composed of 24 companies of the Comstock lode, extending from the Utah on the north to the Alta on the south. Each company is directly interested in the future development of the Comstock, because all are located upon the same great fissure vein and the prosperity of any one has an immediate bearing upon the standing of the others. Through the agency of the one pumping installation at the C. and C. shaft, the water has been lowered to a greater or less degree along the length of the lode. The Sierra Nevada, Union, Mexican, Ophir, Consolidated California and Virginia, and Best & Belcher properties have been drained to the 2,450 level, and it is now possible to work in all these mines at this depth.

The progressive feature in this district is in the direction of combined effort to prospect and develop the lode from one end to the other. When it is operated as one great property instead of by individual companies, greater progress will be made. In May, 1908, L. M. Hall and F. W. Bishop, the engineers of the Comstock Pumping Association, made a very extended report to the association, giving a review of past operations and recent progress in the lode, along the lines laid out for unwatering and developing it. At the end of the report their conculsions are summed up as follows:

> The Union shaft should be sunk, or reopened, to the water level attained through the use of the C. & C. pumps, in order that such connections for ventilation and drainage may be made from time to time as necessity demands and which will permit of exploration on all of the lower levels. The Ophir shaft should be maintained and the air ways put in the best possible condition. The C. & C. shaft should be unwatered to the bottom (2,650 level) and a new system of pumps installed at this point. This attained, the shaft may then be sunk to the 3,000 level and the present system of Riedlers, on the 2,150, lowered into position at the bottom. Working and prospecting to a still greater depth, if desired, could then be continued.
>
> The Ward shaft should be sunk to the 3,150 level, and, as is the present intention, one of the units of the pumping plant now on the ground placed in position at the 3,100 level. Connection with the Combination shaft, for the purposes of drainage and ventilation, should be made on the 2,400 and later on the 3,100 level. Connection from the Ward shaft with Gold Hill should be made on the 2,150 level to relieve the pressure from the south, even if the better plan of placing a plant at the Alta shaft be followed, and, ultimately, connection with Gold Hill made on the lowest level. These connections are imperative because of the fact that work in no one shaft on the Comstock can be carried on successfully without an air connection with some other. The 1,400 level of the Crown Point, from the Overman side, should be connected with the Crown Point branch of the south lateral of the Sutro Tunnel and the water now flowing down the Belcher and Yellow Jacket inclines, unquestionably burdening the pumps now operating on the north end, picked up and carried out through the tunnel.
>
> The wooden stave pipe line in the Sutro Tunnel, and too much importance can not be attached to this recommendation, should be rushed to completion. When this work is done the maintenance of the tunnel will be assured and the expense of repairs greatly lessened. It will be well, also, that this pipe ultimately be covered with concrete, which can be cheaply prepared from the waste rock being transported from the mines. This, in effect, would eventually produce a concrete pipe, easily repaired, and which would last indefinitely.
>
> The south lateral of the Sutro Tunnel should be repaired so soon as finances will permit, inasmuch as the present condition of this lateral precludes the possibility of drainage of the south end of the lode through the Alta shaft.
>
> As fast as the water recedes the Combination shaft must be repaired, ultimately to the bottom, or 3,250-foot level. Ventilation along the entire lode should be revised and proper fans installed. The necessity for revision of the present system is due to the fact that in many cases the modern workings have reached such an extent that the air, heretofore ample, becomes grealy vitiated during its extended course through the mines until a greater flow of air has become a positive necessity.

WASHOE COUNTY.

Washoe County yielded a total output valued at $113,856 in 1907, as compared with that of $70,240 in 1906, an increase of $43,616. The gold output more than doubled; there was slight increase in silver; some copper was produced for the first time; and zinc shows for the first time, but the lead fell off 343,933 pounds.

Olinghouse district or Whitehorse district.—In this district there were 3 producers, the values being nearly all in gold. The Green Hill Mining Company treated a large tonnage in its 50-stamp plate-amalgamation mill, with concentrators and a cyanide plant. The property is opened up by a shaft 200 feet deep and a tunnel 5,000 feet in length. The Olinghouse Nevada Mining Company treated 150 tons at a 2-stamp custom mill in the district. The Nevada Consolidated Mining and Milling Company operated its 50-stamp mill. The Buster Group is under development. It will be two years before full development plans are finished. The shaft on the Golden Wedge is down 110 feet; some ore was mined, but none milled or shipped. The Texas Nevada Gold Mining Company has a gasoline engine and is hoisting from a depth of 200 feet. Water was struck in the deepest workings. The mine was developed and ore blocked out, and the erection of a 5-stamp mill is contemplated.

Washoe or Galena district.—The principal mine in this district is the Stevenson, belonging to the Nevada Commonwealth Mining Company. The ore is said to contain one-half of 1 per cent in copper, 4 per cent in lead, 4 per cent in zinc, 5 ounces of silver, and 70 cents in gold per ton. The reduction plant at the mine is a 300-ton crushing, concentrating, and jigging mill, similar to those at Joplin, Mo. The lead-silver product is shipped to Murray and Bingham, Utah. Some zinc has been shipped, but a very large quantity is held on the dumps awaiting a favorable market. The Virginia and Truckee Railway runs within 400 feet of the mill, and a siding has been built, so that railroad facilities are admirable. The company owns valuable water rights. The mine is developed by a shaft 560 feet deep with levels every 100 feet. The drifts approximate 6,000 feet in length. The Rocky Hill Mining Company operated its mill in 1907. The Galena Hill Gold and Silver Mining Company has not shipped for two years.

Pearine district.—The only producer in this district is the State Line Mining Company, which is as yet only in the development stage. The shaft is down 200 feet, and 500 feet of tunnels have been run. A shipment of copper ore was sent to the Peyton Chemical Company, California. The property is 15 miles northeast of Reno. The Reno Mispah Mining Company has driven a tunnel 855 feet in length. The company is also running a tunnel 1,050 feet long to strike the ore body. At the close of the year all but 150 feet was completed.

Sheepshead district.—The Washoe Lassen Mining Company is the only mine reporting progress from this point.

Jumbo district.—In 1907 building began on the mill for the Selby Consolidated Mining and Milling Company. Since the spring of 1908 some new strikes have been made and lessees have opened up several properties.

WHITE PINE COUNTY.

White Pine County showed an increase of production in 1907 over that in 1906 in all the metals, the principal advance being in lead and this amounting to over 1,000,000 pounds. The larger part of the lead came from the old camp of Hamilton, but there were also increases in production at Cherry Creek and Newark, and the Lead King mines in the Duck Creek district entered the producing lead list. Ely made a small production of copper.

Aurum or Silver Canyon district.—The Siegel Consolidated Mining Company (at Siegel post-office) made several shipments of silver ore to the Murray smelter. The Lucky Deposit mine was also a producer. This mine is now down 100 feet and is also developed by a 300-foot tunnel.

Black Horse and Osceola[a] *districts.*—The San Pedro mines in Black Horse district, under the management of the Amalgamated Nevada Mines and Power Company, increased their production somewhat over that of 1906, notwithstanding being curtailed in output on account of litigation. At Osceola both the Gold Placer Mining Company and the Stalwart mine extracted considerable gold by drifting in the bed of an ancient river. Several small placers added a small amount to the gold production from this district.

Cherry Creek district.—The Biscuit Mining Company, down 900 feet on the incline, shipped silver ore to Utah smelters. The Hartford Nevada Gold Mining Company, operating the old Joanna mine, shipped some high-grade ore to Salt Lake City and milled about the same amount at a local custom mill. The Joanna mine is developed by a tunnel 400 feet in length and a shaft of 75 feet. The Gold Canyon Mining Company made a small shipment. The Vulcan Mining. Smelting, and Reduction Company shipped ore to Murray and reported good returns in silver, lead, and copper. There was much activity in the district. The British Mining Company was sinking a shaft on the Chief of the Hill mine. The Ely Star Mining Company prospected the Black Metal group. The Cocomongo Gold Mining Company was erecting a 4-stamp (Nissen) mill with concentrators to treat its ore and that of the Gold Canyon Mining Company, the Cherry Creek Gold Mining Company (formerly the National), the Gold Canyon Extension Mining Company, and the Antwerp-Nevada Gold Mining Company. The Wide West Mining Company, with a 5-stamp mill, added a steam compressor plant during the year, but reported no production. The Glasgow and Western Company did not work its Cherry Creek mines in 1907, but has decided to build a 100-ton mill on its property in 1908.

Ely district.—The Ely district records production from 1 copper property—that of the Ely Consolidated Copper Company. There are 4 shafts on the property, ranging in depth from 100 to 600 feet. The mine of the Butte and Ely Copper Company was developed by 3 vertical shafts—300 feet, 200 feet, and 180 feet in depth, respectively—and about 1,000 feet of drifts were run. The Ely Gibralter Mining Company extracted several tons of high-grade lead ore, but no shipments were made. The Federal Ely Copper Company, a former lead producer, is being developed for copper. The Giroux Consolidated Mining Company is down 1,000 feet on the Alpha shaft. The company built in 1907 a 1,000-ton concentrating mill, with jigs and Wilfley tables. The company anticipates operating the mill throughout 1908. The Mispah Consolidated Gold and Copper Company started work in 1907 and extracted some copper ore, but shipped none. The McDonald Ely Copper Company is down 400 feet in one shaft, 200 feet in another, and 280 feet in a third. There is a 50-ton cyanide plant on the property, but it was not operated. The Nevada Consolidated Copper Company and the Cumberland Ely, under one management, concentrated their efforts on completing the 4,000-ton concentrator and the 1,000-ton smelter, with McDougall roaster and 3 reverberatories, at McGill, 20 miles from the mines. The mine operations were to commence in April, 1908, and the smelting and concentrating plant was to be completed in June, 1908, but the smelter was not blown in until August, 1908. The Ruth mine was down 500 feet in 1907. It is to be worked by the caving system. The Copper Flat mine is to be worked by steam shovels. The 2 companies, besides developing the mines, have built 200 miles of railroad track. The total expenditure of $20,000,000 is said to have been made in acquiring the mines and in preparing to treat the ores.

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[a] Bull. U. S. Geol. Survey No. 340, 1908.

The Success mine was developed to a depth of 300 feet on the incline. Ely and its mines have been well described by Walter Renton Ingalls[a] and Leroy A. Palmer.[b] A geological report has been published by Prof. Andrew Lawson.[c]

Hamilton district.—With a production of over 1,000,000 pounds of lead from 4 mines, Hamilton took second place after Eureka in lead production in Nevada. From the Julia mine were shipped several carloads of ore to Salt Lake City, which yielded silver, copper, lead, and zinc. The Rocco-Homestake Nevada Mining Company shipped lead ore to Salt Lake City. The ore contained 63 per cent of lead and 13 ounces of silver, with some copper. The Ne Plus Ultra mine, of the Whitepine Lead Company, was one of the largest producers in the district, with lead as the leading metal. From the Young Treasure was shipped the largest tonnage of the year. The ore in this mine is lead-silver, with principal values in lead. The mine is developed by an incline shaft 300 feet deep and a tunnel 350 feet long. Another tunnel is being run to tap the works at a depth of 700 feet. The Comanche mine, down 185 feet on the incline, made no production. The Jennie and Black Rock Mining Company shipped no ore. The Protection, Protective, and Rex mines were worked, but no ore was shipped from them. These mines are down 1,600 feet on an incline 2,200 feet long.

Newark district.—The Bay State mine of the Newark Mining and Milling Company shipped several carloads of silver-lead ore from this district.

Duck Creek district.—The Lead King Mining and Milling Company (near McGill P. O.) shipped in 1907 galena ore running 70 per cent in lead and 3 ounces to the ton in silver. There are 2 incline shafts on the property, one 120 feet in length and the other 70 feet. The tunnels aggregate about 500 feet in length. The mines will find a market close at hand at the Ely (or Steptoe) Smelter.

Ward district.—The operators of the Nevada United Mines at Ward spent the year 1907 in developing. The workings were 280 feet deep in 1907, and in August, 1908, shipping commenced.

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[a] Eng. and Min. Jour., October 19, 1907; November 2, 1907.

[b] Mining World, June 20, 1908.

[c] Bull. Dept. Geol. Univ. California, vol. 4, No. 2.

NOTES ON THE METALLURGICAL TREATMENT OF NEVADA GOLD-SILVER ORES.

TONOPAH DISTRICT.

The first serious attempt to treat the ores of this district was made at Tonopah in 1901. The lessees of the original Mizpah vein (a territory now owned by the Tonopah Mining Company) formed a company for the purpose of erecting a mill to treat their dump ores, too low grade for shipment. This plant, known as the Midway mill, was designed on the assumption that concentration and cyaniding were not adapted to the Tonopah ores, and that pan amalgamation was the correct process. Ten stamps were installed and the Huntington mills were used for regrinding. The ore was finally treated by the Boss continuous-pan process. An extraction of about 86 per cent of the silver was claimed for this mill during the few months of operation, at a cost of about $11 per ton for treatment. The development of other and cheaper processes finally lead to shutting the plant down. It subsequently became the property of the Tonopah Mining Company, who dismantled the pans and remodeled it for cyaniding, after adding 10 stamps to the equipment. But the high cost of treatment and poor results obtained soon caused the company to abandon the mill, and for nearly two years it has lain idle.

THE DESERT MILL.

At Tonopah, the first mill to use the cyanide process was built by the Tonopah Mining Company at Millers, about 13 miles west of Tonopah. Later, a second mill (of 60 stamps) was erected adjoining the Tonopah Mining Company's plant to treat the ore of the Belmont Mining and Development Company. This mill is similar to the larger plant, and needs no special description. The third plant is that of the Montana-Tonopah Mining Company, built on a hillside above Tonopah.

The 100-stamp mill and power plant of the Desert Power and Mill Company, milling the ore produced from the mines of the Tonopah Mining Company of Nevada, is located at Millers. The installation of both mill and power plant was made by Chas. C. Moore & Co., of San Francisco. The main mill building, 525 by 230 feet in extreme dimensions, is erected on ground having only a 3 per cent slope. The crude ore from the mines is taken up an incline trestle in steel hopper-bottom 50-ton railroad cars, in lots of 7 cars, to the crusher ore bin. Water for the mill and power plant is pumped by a 2-stage vertical centrifugal pump from a well 60 feet deep, situated 1,700 feet north of the plant.

The following description is condensed from an article by A. R. Parsons, in the Mining and Scientific Press:[a]

> The crushing plant has a capacity of 400 tons in eight hours. Power for driving the machinery is supplied by a 125-horsepower motor and the Robins belt conveyor for carrying ore from the crusher house to battery storage bin is driven by a 15-horsepower motor.
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> The mine run from the bin is fed through a finger gate to a Gates crusher. This reduces it to a maximum size of about 2 inches, in which condition it is elevated by means of a bucket elevator to a 48-inch by 16-foot revolving screen

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[a] Min. and Sci. Press, vol. 95, October 19, 1907, p. 494.

with 1¼-inch holes. The oversize from the screen passes to two Gates crushers for further reduction. The product from the smaller crushers unites with the screened product and passes through a Snyder sampler. The reject from the sampler falls directly upon the conveyor. The product from the rolls is passed through a Snyder sampler, the reject from which falls upon the conveyor. The conveyor takes the ore up a 22-degree incline and distributes it by an automatic tripper over the battery storage bin, having a capacity of 1,500 tons.

Twenty Challenge feeders supply the 100 stamps. Each battery of 20 stamps is driven by a 50-horsepower motor. The 1,067-pound stamps drop 104 times a minute through a height of 6½ inches and have a duty of 4.34 tons crushing through a 12-mesh wire screen, the height of discharge being 3 inches.

The battery crushing takes place in a solution carrying 0.15 per cent potassium cyanide, supplied from a storage vat. The pulp from the battery flows to an inside bucket-elevator wheel. The wheel elevates the pulp to ten 20-inch double-cone classifiers with hydraulic upward current of cyanide solution. The overflow from the classifiers passes directly to 10 Wilfley concentrators. The bottom discharge, containing the coarse product for regrinding, flows to 5 Huntington mills, equipped with 30-mesh screens. Three mills ordinarily regrind the oversize product from 80 stamps.

Classification and dewatering of the product to the Wilfley concentrators is obtained by a series of V-boxes receiving the pulp from the launders carrying the overflow from the 10 double-cone classifiers and reground product from the Huntington mills. It is intended to install additional concentrators to take the middling from the present equipment, as experiments have demonstrated that an additional saving of about 10 per cent can be made in concentrating, at the same time removing sulphides difficult to treat in the cyanide department. At present, 90 tons of ore produce 1 ton of concentrate, averaging 4.5 ounces gold and 815 ounces silver per ton. These are partially dried and sacked each day in canvas bags and shipped to the smelter in carload lots. The recovery by concentration from March to August, 1908, was 15.63 per cent of the gold and 30.32 per cent of the silver contents of the ore milled.

The tailing from the concentrators is elevated by means of a wheel to two sets of ten double-cone classifiers with hydraulic upward current of weak solution. The overflow from the upper set of 24-inch classifiers goes to the lower set 36-inch diameter. The overflow slime and solution from the lower set of classifiers flows to the slime plant through a series of spitzkasten for removing the very fine sand.

The sand and solution from the spigot discharge of both sets of classifiers and spitzkasten flow through a wooden launder to a revolving wet distributor of the Butters & Mein type. This distributor is hung from a circular overhead trolley so that it can be swung to any one of four sand-collecting vats. These, as well as the 18 leaching vats, are 33 feet diameter by 8 feet deep, provided with cocoa matting and 10-ounce canvas filters laid on wooden strips, the filters being raised 3 inches above the bottom of the vat. The collecting vats are provided with roller blind overflow gates for a further separation of sand and slime. Some sand that overflows with the slime from these gates is removed by a large pointed box receiving the entire overflow from collectors. The slime and solution from the pointed box are returned to the launder going to the slime plant by means of a 4-inch Butters centrifugal pump.

For treating the sand, a collector is filled to a depth of 5 feet; this amount of packed sand, after transfer, fills a treatment vat. After a collector is filled the distributor is swung to one of the other collectors and the drain valves opened for twenty-four hours; then a vacuum is applied to dry sufficiently to permit of excavating by means of a Blaisdell disk excavator. This machine is mounted on a track and can be moved by electric motor and trolley to any sand vat. It requires from two to three hours to excavate 250 tons of sand. The excavated sand is conveyed to a cross conveyor at the east end of the sand vats. The cross conveyor, running up an incline, discharges to a conveyor of the same type running between the two rows of vats and above them, over a Blaisdell tripper. From the tripper the sand falls upon the cross belt of a Blaisdell sand distributor, then onto a rapidly revolving disk with speed-regulating device, by means of which the sand is distributed about the vat in a fine shower and at the same time thoroughly aerated.

While transferring the sand from collectors to leaching vats lead acetate, previously dissolved in water (½ pound per ton) is allowed to drip upon the sand on the conveyor belt and slaked lime (4 pounds per ton) is thrown into the collector in which the excavator is working, thus thoroughly mixing the lime with the sand. The first leaching solution, amounting to 30 tons, is brought up to 0.25 per cent strength. This pumping of strong solution is allowed to drain slowly through the partially opened drain valves and is followed by repeated pumpings of weak solution from 0.15 to 0.20 per cent, after which the charge is drained for transfer. This first treatemnt occupies five days, including time of transfer.

The second treatment averages five days and consists of repeated pumpings of strong and weak solution that are drained and the sand transferred to another vat for the final treatment, which consists of as many pumpings of wash solution as there is time to apply, followed by two or three pumpings of water to displace all the solution. Then the vat is finally drained by vacuum for discharging from the plant. All pumpings of solution are allowed to disappear below the surface of the sand before the succeeding one is applied. Sand undergoes treatment for twelve to fifteen days. Sand residues at present average 0.03 ounce gold and 3.10 ounces silver per ton.

The treated sand is discharged by the excavator, and as it is discharged falls upon a cross conveyor running up an incine of 25 degrees. As the tailing pile builds up to the stacker, an extension of 18 feet is added at the end.

The slime plant has 11 3-inch redwood vats 36 feet diameter by 20 feet deep for collecting and agitating slime; 1 vat of the same dimensions used in connection with the Butters filters for stock pulp, 2 Butters filter vats containing 96 filter frames each, and 2 tanks 24 feet diameter and 12 feet deep used for weak solution and water for washing slime on filters.

All of the 11 vats mentioned above are provided with rim overflow launders for receiving the clear overflow when collecting slime. The overflow goes to any of the 3 sump tanks, 40 feet diameter by 8 feet deep, from which it is returned to the battery storage tank by a centrifugal pump. Eight of the 11 vats are provided with mechanical arm agitators driven by a 30-horsepower motor with gearing and friction clutches over each vat. Agitators make 5 revolutions per minute. There are 2 sets of 4-arm agitators quartering. The lower set, to which drags are hung for keeping the heavier fine sand in suspension, is 2 feet, and the upper set 8 feet from the bottom. Any of the 8 vats can be used for agitation, although at present but 4 are in use at the same time, leaving 4 of the agitation vats and the 3 regular collectors for service in receiving and collecting the slime in the slime-bearing solutions. A charge of slime is drawn from the bottom of the collecting vats by means of an 8-inch centrifugal pump without interrupting the collecting.

Previous to receiving a charge of thick pulp from the collectors, about 150 tons of barren solution is pumped into the agitator. To this is added 1,000 pounds slaked lime and 600 pounds dissolved cyanide; the whole is agitated for one hour by the mechanical agitators and pumps. The charge of thick pulp is then pumped in. When thoroughly mixed it has an average specific gravity of 1.144; that is, 21 parts of slime to 79 of solution. The mass is agitated for thirty hours, the mechanical agitation being assisted by compressed air, admitted through a perforated pipe running half across the bottom of the vat and by an 8-inch centrifugal pump, taking pulp from the bottom and discharging at the top of the vat. The pulp is allowed to settle for six hours, when about 5 feet of clear solution is decanted and run to the storage vats for precipitation. The settled slime is then pumped to a second agitation vat into which solution equivalent to that decanted has been pumped; agitation is continued for twenty-four hours, when the contents are delivered to the Butters filter stock vat.

Vacuum for the filters is supplied by a 10 by 10 inch duplex vacuum pump, driven by a 15-horsepower motor. The first solution coming through the vacuum pump, upon beginning a new cycle of operations, is turbid and goes to the circulation pumps. When the solution becomes clear, usually in five minutes, it is turned to the storage vats for precipitation.

The thick slime cake, having been discharged, is broken up for pumping by means of 1-inch jets of water under a 70-foot head directed downward into the hopper of the filter vats. The cake is discharged in the wash solution by admitting water under a 12-foot head. The wash solution is allowed to settle for about five minutes before running back and then is drawn off to within about 6 inches of the thick slime in the hopper. By this means and the small amount of water from the jets, the slime can be easily pumped out with a moisture content of 60 per cent. At the present time an average of 125 tons of dry slime is being filtered and discharged per twenty-four hours.

All solutions for precipitation are collected in two tanks, 24 feet diameter, 8 feet deep. From these the solution is pumped through a Worthington meter to the zinc boxes by means of 2 centrifugal pumps.

There are 14 zinc-boxes made of 3-inch redwood. Each box has seven compartments, each holding 15 cubic feet of zinc shaving above the screen trays, making the total capacity of the box 105 cubic feet, or about 1,600 pounds of zinc shaving. The compartments of the boxes are arranged for an upward flow of solution.

The average amount of solution precipitated in twenty-four hours is 1,200 tons. The tailing from the zinc boxes assays from a trace to 11 cents per ton, increasing in value from the time immediately after one clean up to the time of the next. Four clean ups are made each month. After washing, the precipitate is dried in pans in a muffle furnace together with that collected from the washing solution in the filter presses. It is then thoroughly roasted, then pulverized and fluxed with 20 pounds of borax, and 16 pounds of bicarbonate of soda per 100 pounds of precipitate. Formerly it was the custom to treat all the zinc-box product with sulphuric acid before filter pressing. This practice required extra labor, expense, and time, and has been discontinued, as there was no appreciable increase in the fineness of the bullion produced.

The melting is done in 6 Faber du Faur tilting furnaces, with graphite retorts, and a capacity of 80 pounds of fluxed precipitate. From 70,756 pounds of roasted precipitate, 47,442 pounds of bullion were produced—that is, without acid treatment 67.05 per cent of the precipitate went into bullion. This bullion had an average fineness of gold 13.5, silver 965, total 978.5 per thousand. The bullion bars weigh about 1,200 ounces troy.

The difference between the gross content of the ore and the gold and silver in the concentrate shipped, is taken as the gold and siver contents going to the cyanide plant. The extraction by cyanide is estimated from this by comparing with the total ounces of gold and silver shipped as bullion and refinery by-products, with the total contents in sand and slime residues as a check. The extraction by cyanidation from March 1 to August 1, 1907, figured in this manner, is 86.06 per cent of the gold and 80.14 per cent of the silver contents. Combining this with the extraction by concentration, as above, 15.63 per cent of the gold and 30.32 per cent of the silver, gives a total extraction by concentration and cyanidation of 88.24 per cent of the gold and 86.20 per cent of the silver in the ore.

The average consumption of chemicals per ton of ore, for five months, was: potassium cyanide, 3.24 pounds; lime, 7.20 pounds; lead acetate, 0.38 pound; zinc shaving, 1.10 pounds; zinc shaving consumed per ton of solution precipitated, 0.32 pound.

MONTANA-TONOPAH MINING COMPANY'S SILVER MILL.

The Montana-Tonopah Mining Company's plant for wet milling and cyaniding silver ores was designed and erected under the supervision of F. L. Bosqui and built by the Allis-Chalmers Company. It possesses certain unique features that may be considered innovations in the metallurgy of silver.

The ore is a gold and silver bearing sulphide. The chief gangue mineral is quartz. In the milling ore the proportion of gold to silver by weight is 1 to 100. Some of the gold is undoubtedly free, the remainder being associated with the silver in the sulphide. The prevailing silver minerals are stephanite and polybasite; and beautiful specimens of ruby silver have been taken from the richer portions of the mine. Lead, copper, and zinc also occur in small quantities.

The ore as it comes from the mine is delivered to a 200-ton steel bin, which stands directly in front of the head-frame and adjoins the primary crushing plant. From this bin the ore is fed through a counterbalanced gate to a Gates gyratory breaker, which reduces it to a size of 2 inches. Thence it passes to a bucket elevator that discharges into a revolving screen with 1-inch perforations. The oversize from this screen is recrushed in 2 Gates breakers to 1-inch size, this product then joining the undersize from the screen and passing to a belt conveyor, which conveys the ore to the mill bins. This belt is 190 feet long and operates at an angle of 12 degrees. It discharges upon a horizontal belt extending the length of the bins, the latter being provided with a tripper for distributing the ore. The crushing plant has a capacity of 25 tons per hour, and is operated only during one 8-hour shift. From the bins the ore is delivered by 8 Challenge feeders to a battery of 40 stamps. The stamps weigh 1,050 pounds and fall 100 times per minute through a 7-inch drop. The shoes are of chrome steel.

The ore is crushed in cyanide solution through 20-mesh wire screen with apertures of 0.0173 inch. The strength of the circulating mill solution is 0.13 per cent of sodium cyanide.

From the battery the ore goes to eight 24-inch cone-classifiers. The spigot discharge feeds 8 Wilfley concentrators, the slime and fine sand overflow joining the main pulp stream after concentration. The whole mill stream is then elevated to 2 Dorr classifiers for dewatering and further classification, preparatory to tube-milling.

The 2 tube mills in use are 5 feet by 22 feet in dimension, lined with 4-inch silex blocks. They make 27 revolutions per minute. Each mill is now regrinding 52 tons per twenty-four hours, the safe limit for this ore.

The pulp from the tube mills, after proper dilution, is reclassified in two 48-inch cones. The underflow from these is returned to the mills; the overflow joins the stream from the lower ends of the Dorr classifiers, and is then elevated by sand pumps to 2 thickening cones, preparatory to secondary concentration in Frue vanners.

The Frue vanners do good work on this fine product. The concentrate from the Wilfleys and vanners is removed by traveling buckets to a drying house adjoining the mill, where it is sacked for shipment to the smelter. From the lower concentrating floor the whole reground mill pulp goes to the cyanide plant for treatment by agitation. All cyanide tanks are made of redwood, excepting the Hendryx agitators. The mill pulp, containing 6 parts of cyanide solution to 1 of ore, is fed alternately to the center of 2 settling tanks 30 feet in diameter by 10 feet deep at the center, with a false bottom sloping 12 degrees.

These tanks are provided with leveling rim, overflow launders, and decanting apparatus. By means of a series of decantations the pulp is reduced to the proper consistence for agitation. There are 6 Hendryx agitators in use 17 feet in diameter. It requires 6 horsepower to agitate a charge of 35 tons of ore (dry weight). A 0.2 per cent solution of NaCy is used, and 0.3 pounds of lead acetate ore added per ton of ore. The agitation is continued for thirty-two hours. The pulp is then raised to a pulp-storage tank, 30 feet in diameter by 17 feet deep, provided with stirring arms making 8 revolutions per minute. From this tank the pulp is drawn as required into the Butters filter boxes.

The Butters plant consists of 2 redwood boxes of 4 compartments each. Each box contains 72 filter leaves. The solution from the Butters filter is refiltered in a 30-inch frame filter press, whence it flows to the precipitation tanks. There are 3 of these, each 14 by 14 feet in dimension. The zinc dust is added as an " emulsion " from a small feed cone, and passes directly into the suction of the pump, which raises the solution to the Merrill precipitation presses set up in a separate building, 100 feet above the precipitation tanks, and immediately above 2 solution storage tanks 28 feet by 8 feet. These 2 presses have triangular-shaped plates, 48 inches on edge. There are 30 plates in each press, with frames spaced 2 inches apart. From the presses the barren solution runs to the storage tanks, whence it passes into the general mill circulation. The present method is to draw from the circulating mill supply of solution the quantity required for agitation purposes. This quantity is brought to the required strength in the agitators, and, after precipitation, it passes again into the mill circulation; so that there is really but one solution used throughout. The value of the mill solution is kept low by precipitating about 150 tons of it daily. That portion of the mill solution which is not used for extracting purposes overflows the rim of the settling tanks almost clear, but is further clarified by flowing through a 3-compartment, pointed, clarifying box, each compartment being 10 feet square at the top. Thence it flows to the mill pump and is pumped to a 70,000-gallon concrete reservoir on the hillside above the stamps.

Zinc-dust precipitation, as used by C. W. Merrill at the Homestake plant, South Dakota, and elsewhere, has been satisfactory in the practice at Tonopah from the first. It has the advantage of compactness, low cost for labor, and security from theft.

The precipitate is sacked and shipped to the smelter. The high cost of fuel, fluxes, and labor would not justify refining this product on the ground.

Although this mill has made the record on costs for this district, all the costs are in reality high. Water, power, freight rates, and labor are expensive items. The following figures are given by G. H. Rotherham to illustrate a few of the difficulties incident to milling operations in Nevada:

Cost per ton of milling ore at Montana-Tonopah Silver Mill, October, 1907, to May, 1908.

	Tonnage treated.	Cost, per ton, milling and cyaniding.		Tonnage treated.	Cost, per ton, milling and cyaniding.
October, 1907	4,120	$4.25	February, 1908	4,383	$3.59
November, 1907	4,410	3.79	March, 1908	4,701	3.28
December, 1907	4,256	3.58	April, 1908	4,303	4.08
January, 1908	4,135	3.59	May, 1908	4,458	3.67

These figures do not include insurance and depreciation on plant.

In explanation of these costs, the following items may be of interest:

Average cost of water per ton of ore treated	$0.287
Average cost of power per ton of ore treated	.808
Average cost of labor per ton of ore treated	.943
Total	2.038

RÉSUMÉ OF METALLURGY OF TONOPAH ORES.

These ores are essentially silver ores, the proportion of silver to gold by weight existing in the approximate ratio of 100:1. In the Tonopah and Belmont mines the ores now worked are oxidized; in the Montana, McNamara, West End, and Extension mines the ore is mainly a sulphide. Zinc, manganese, and copper are present in all the mines, but not in quantities sufficient to interfere seriously with wet milling and cyaniding. It is interesting to note the two different modes of treatment by the cyanide process. The older method of leaching by percolation has been supplanted in the Montana mill by fine grinding and agitation, a method which is now generally acknowledged to possess distinct advantages over the older system. In the Montana-Tonopah mill the treatment of silver ore by cyaniding has perhaps reached the point of highest efficiency, comparable with the best work done in Mexico.

GOLDFIELD DISTRICT.

At Goldfield the subject of ore treatment early engaged the attention of mine owners, and in 1903 the Combination Mines Company employed F. L. Bosqui, of San Francisco, to make experiments and design a mill. The Combination plant was finished in 1905. It has since undergone several modifications due to changes in the ore as mine development progressed. The mill as it stands can hardly be considered one of the model plants of the district, although it has always done excellent work and has proved the merits of the process which will be introduced in the new 100-stamp mill of the Goldfield Consolidated Mines Company. The Combination mill will be abandoned as soon as the new mill is in operation. A description of mill and process—"Ore treatment at the Combination Mine, Goldfield, Nev."—was published by F. L. Bosqui in the Mining and Scientific Press in 1906.[a]

Several small custom mills have been erected in Goldfield, most of them poor affairs and now abandoned. The only surviving wet-crushing custom mill is that of the Nevada Goldfield Reduction Company.

NEVADA GOLDFIELD REDUCTION COMPANY'S MILL.

This plant includes a sampler, with a capacity of 450 tons per day, and a cyanide mill treating 100 tons per day. The surplus ore is sold to the smelting companies. The equipment of the mill includes 20 stamps of 1,250 pounds each, by which the ore is crushed to 12 mesh in a 0.50 to 1.25 pound cyanide solution. The pulp from the mortar goes over amalgamating plates and then to 8 Wilfley concentrators, classifying into 3 products, namely, concentrate, sand, and slime. The concentrate assays in value from $200 to $1,000 per ton and is shipped to the smelters; the sand goes first to an Allis-Chalmers 5 by 22 feet tube mill, which reduces it to a screen size of less than 100 apertures per linear inch; from the tube mill the reground product passes over supplementary amalgamating plates and then to classifiers, the oversize from which is reground after going over a Wilfley table. The leaching plant, which receives the pulp after the free gold and rich sulphides have been partly extracted by concentrators, includes 8 vats 22 by 5 feet and 3 agitator vats 24 by 16 feet. Three vacuum filters of the Butters type strain the gold-bearing solution, which is further clarified by passage through a 5-ton American filter press.

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[a] Min. and Sci. Press, October 6 and 13, 1906.

THE CHLORINATION MILL.

A chlorination mill for treating custom ore has recently been erected at Goldfield by Mr. J. E. Greenawalt, of the Goldfield Mill Company. The roasting furnace is a 100-foot rabble roaster of the muffle type. It is heated by producer-gas manufactured from Utah coal enriched with California crude oil. From this furnace the roasted ore goes to a cooling cylinder, at the end of which it is moistened before delivery into a bin. From the bin it is transferred to large vats by means of a grab-bucket of a capacity of 60 cubic feet, or nearly 3 tons, operated by a traveling electric crane. The chlorination vats are of wood. When silver ore is being treated 2 per cent of salt is added before crushing. The leaching in the vats, which requires 3 to 4 days, is done by a strong solution of chlorine in water of 7 to 8 pounds free chlorine per ton of solution. The 7 vats are each 22 feet in diameter and 8 feet deep. The gold solution is withdrawn by gravity and pumped into a storage vat and thence drawn to the precipitating boxes, resembling the zinc box of a cyanide plant. The precipitation of the gold is effected electrolytically, the anode being graphitized carbon, and the cathode lead shaving containing 1 per cent of zinc. The slime of lead, gold, and silver while still moist is mixed with flux and briquetted. The briquettes are melted in a reverberatory furnace and then refined in a cupel.

The chlorine is generated electrolytically. At first salt was obtained from Hazen, in Nevada, but it was found to contain over 5 per cent of silica from sand blown across the dry lake; the salt now used comes from Salt Lake City and costs $16.25 per ton delivered. The solution of chlorine water is made in an absorbing tower, which consists of 2 sheet-iron stacks lined with glazed sewer pipe, with cement between the pipe and the outer iron. Inside is placed a filling of hollow clay balls, each of them having 8 perforations. The chlorine gas is introduced at the bottom of the stacks and water is made to trickle down from the top, the large surface thus offered facilitating absorption.

The mill has a nominal capacity of 100 tons per day. The ore is crushed to 14 mesh. A peculiar feature of the plant is the use of piping made of hard rubber.

NEW MILL OF THE GOLDFIELD CONSOLIDATED MINES COMPANY.

The new mill of the Goldfield Consolidated Mines Company, now in process of erection at Goldfield, will represent the result of several years of extensive practice and observation, and may be expected to be in all respects a model plant. It was designed under the supervision of F. L. Bosqui, as consulting metallurgist, and G. B. Shipley, as engineer for the Allis-Chalmers Company. The mill is 2 miles north of the mines. The ore will be transported over a railroad in 25-ton hopper-bottom cars and delivered into a bin of a capacity of 850 tons. The mill is expected to treat 600 tons per day. From the bins the ore will pass to a Gates gyratory crusher, which will deliver it by elevator to a revolving screen (4 by 14 feet) having 1½-inch apertures. The undersize will go to a belt conveyor, the oversize to 2 Gates crushers and then to the belt conveyor, which will elevate the final product from the ore breaker up a slope of 20 degrees, and 370 feet long, into the sampler. From the sampler the ore will be distributed by a belt running over the mill bins, which have a capacity of 4,000 tons. Suspended Challenge feeders will deliver the ore into 20 mortars, each containing 5 stamps. The mortars are of the narrow Homestake pattern, but with broad bases and extra heavy, set on concrete blocks. After being crushed under the 1,050-pound stamps the ore will pass over silver-coated amalgamating plates 5 feet wide by 16 feet long. Thence the pulp will descend to 20 double-cone classifiers 24 inches in diameter. The overflow will pass directly to concentrators, while the underflow goes to 6 Dorr classifiers which thicken the pulp previous to its introduction into tube mills. There are 6 tube mills, each 5 by 22 feet, of the Allis-Chalmers trunnion type, lined with 4-inch silex blocks. The product from the tubes will be classified in four 48-inch double cones, the overflow from which will pass to 14 secondary amalgamating plates, while the underflow is returned to the tube mills.

The slimed pulp, of which 80 per cent will pass a 200-mesh screen, will join the overflow from the secondary amalgamating plates and proceed to the concentrators. Concentration will be done in one stage only, namely, after tube milling. The concentrator used will be either the suspended Frue vanner or the Deister table, and 60 machines will be required. The stream from these vanners will join the overflow from the Dorr classifiers and pass to the settling department. This consists of 16 tanks of 30 feet diameter, 12 feet deep, provided with 16-degree cone bottoms. In these tanks, by means of serial decantation, the pulp will be reduced to a consistence of 50 per cent of moisture. Then it will be transferred, partly by gravity and partly with the aid of a large centrifugal pump, into steel agitator vats operated on the air-lift principle and known as Pachuca tanks. There will be 10 of these tanks 15 feet in diameter and 45 feet deep. The water overflow from the settlers will be conveyed to a series of clarifying tanks and raised to the mill reservoir, whence it will be again put into circulation through the mill. From the Pachuca agitators, where the pulp will be circulated in a cyanide solution for from ten to eighteen hours, the material will be transferred to large reservoirs, in which it will be kept in gentle motion, and from these it will be drawn as required into the 2 boxes of the Butters filters, constructed of steel and with a capacity of 168 filter leaves. After the desposition of the cake on the frames, the surplus pulp will be drawn off into a large vat on a lower level. Similar vats will be provided for both water and solution—that is, the Butters plant will be operated by gravity throughout.

The solutions from the Butters filters will be clarified in 3 Perrin filter presses, each having 50 frames 36 inches square. From these clarifying presses the solution will be drawn to the precipitation vats, where zinc dust will be added. The precipitate will be gathered in four 30-frame Merrill presses, and the product melted direct (without acid treatment) in 5 Faber du Faur tilting furnaces. An extraction of 95 per cent of the gold is expected, the silver content of the ore being negligible. The total cost of milling is to be under $2.50 per ton—a low figure, having regard to the high prices of water, power, and labor.

The Goldfield Florence Mining Company commenced the erection of a mill about a year ago, patterned somewhat after the Combination mill. The completion of the plant is awaited with much interest, inasmuch as the ore is the most difficult in the district to treat, by reason of its copper content.

RÉSUMÉ OF METALLURGY OF GOLDFIELD ORES.

These ores have never, from the first, offered any serious obstacles to wet-milling methods. The ore may be briefly described as a silicified andesite and dacite, carrying in a fine state of division, in varying proportions, a rich, gold-bearing iron pyrite and a considerable amount of free gold in a fine state of division. In milling, a distinction is made between the oxidized or surface ore, and the sulphide or deeper-level ore. The latter, however, is not a heavy sulphide, but it contains sufficient ore mineral, including a small amount of tellurium, copper, and bismuth, to emphasize the need of close concentration. In the Daisy and Florence mines the presence of considerable quantities of copper would seem to justify a preliminary roast, followed by chlorination or cyaniding. At all events, the ore of this camp is in no sense a smelting ore. The concentrate from the Combination mill is now being treated by the cyanide process, after a preliminary acid wash to remove the copper.

The gold does not amalgamate readily, only about 35 per cent being saved on the plates. Cyaniding has been from the first an important factor in the treatment of these ores. Treatment by percolation of a part of the product and the agitation of the slime has been the prevailing method. But after the introduction of tube mills into the district the tendency has been toward the sliming of the whole mill product. For filtering, the Butters filter has been in general use and has given satisfaction. (For tube-mill and filter data at Goldfield, see "Recent Improvements in the Cyanide Process," by F. L. Bosqui.[a]) Concentration has been tried in various ways, but experience has shown that the most economical method is to concentrate the slimed product after tube milling. The sulphide is in the first instance so finely divided that its further comminution in the tube mill does not seem to increase perceptibly the difficulty of concentration.

BULLFROG DISTRICT MILLS.

At Rhyolite, Nev., there are two mills of importance—the plants of the Montgomery-Shoshone Mining Company, and the Homestake King Mining Company. These differ essentially. At the Montgomery-Shoshone the ore is crushed in rolls, with cyanide solution, then elevated, and treated by amalgamation, concentration, and cyaniding. The descent of the pulp from the top of the 60-foot bucket elevators is by gravity throughout. The sand is treated by percolation, the slime by agitation, and filtering is done in the Butters filter.

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[a] Min. and Sci. Press, December 15, 1906.

The Homestake King Company has availed itself of the later and more approved method, and resorted to sliming in tube mills. This plant of 20 stamps is constructed along the same lines as the Montana-Tonopah plant, except that concentration is omitted.

THE MONTGOMERY-SHOSHONE MILL.

The new plant of the Bullfrog Reduction and Water Company at Rhyolite, Nev., was built under contract by the Traylor Engineering Company, of New York, and was recently described in full in Mines and Minerals by P. E. Van Saun.[a] The following paragraphs contain a condensed statement of this paper:

All of the mill machinery is driven by electric motors in units to suit the installation, the concentrators being driven with independent motors to avoid any possible fluctuation in speed. The pumps, likewise, are driven by a separate motor so as to regulate the speed and capacity of each set. Water for the plant is pumped for a distance of about 1 mile into a large storage tank placed on the hill in order to give ample gravity pressure for the plant. The values are approximately $30 per ton in gold and silver, contained in a quartz and clay gangue. The coarser particles of gold and silver are extracted by amalgamation on regulation copper plates, after crushing and sizing; the finer sulphides, consisting of about 2 per cent of the weight of the ore, are recovered in the shape of a high-grade concentrate on reciprocating concentrating tables. The values contained in the slimes and sand tailings from the above processes are recovered in the cyanide department.

The sand treatment in this description by Mr. Van Saun will be kept separate from that of the slime product in order to avoid confusion.

Sand treatment.—From the reciprocating tables the sand product is run to the hopper of a swinging launder, by which the sand may be sent to either of the two receiving sand tanks 36 feet in diameter by 6 feet 6 inches deep. These two tanks are used alternately, and each is provided with three roller gates so that as they are filled with the sand product the water and slimes will overflow, the gates being raised as the tank is filled. This overflow product is run into a sand trap or classifier, from the bottom of which the settled sand products, together with the necessary water, are pumped by centrifugal pumps to the distributing launder and thence back into the sand tank. The slime product is pumped by centrifugal pumps for slime treatment, as described below. When either of the receiving tanks has been filled with sands a vacuum connection is turned on under the filter, covering the entire bottom of the tank so as to thoroughly drain the contents. The vacuum connection is then closed and the accumulated liquid is allowed to flow by gravity into the above referred to sand trap. After the sands have thus been freed of superfluous moisture in the receiving tank, the center plug gate is removed and the Blaisdell excavating machine run over the tank, by means of which the sands are discharged onto belt conveyors and are delivered to the Blaisdell distributing machine for uniformly feeding and aerating the product in the leaching tanks. There are five of these sand leaching tanks each 36 feet in diameter by 6 feet 6 inches deep; they are of steel, as are all of the other tanks in the cyanide department. After a leaching tank is filled it is treated in the usual way with cyanide solution, the piping being so arranged that the solution may be admitted either on top of the charge or beneath the filter, as may be advisable.

The resulting gold solution is allowed to flow from beneath the filters to either of two gold-solution tanks, 20 feet in diameter by 8 feet deep, one for weak and the other for strong solution. The sands are drained by means of a vacuum which withdraws the solution and delivers it to a sump tank, and from thence either directly to the zinc boxes, or if it is desired to store the solution it may be run to the two gold-solution tanks before mentioned, from which it is drawn to the zinc boxes. Ten improved steel zinc boxes are provided, each with seven compartments, arranged so that each compartment can be cleaned separately. From the sump tank the solution is dumped into either of two solution tanks placed on the hill above the plant, one for weak and one for strong solution, and restandardized as required. The zinc-box products will be treated as described farther on in connection with the slime treatment.

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[a] Mines and Minerals, vol. 28, March, 1908, p. 385.

The sands in the leaching tanks, having been treated with cyanide solution, are washed, drained, and delivered by a belt conveyer system to the dump.

Slime treatment.—The slime product coming as tailings from the vanners is run by gravity launder to the sand trap before mentioned, the trap also receiving the slime overflow from the roller gates of the two receiving tanks. The overflow product from this trap, which will contain all of the slimes from the entire previous treatment, is pumped by means of centrifugal pumps into either of two 20′ by 12′ steel thickening tanks. These are provided with an overflow launder around their entire top circumferences. The thickened pulp is drawn off from a large cone in the bottom of each tank by means of a flexible connection, so as to vary the head against which the flow occurs and thus regulate the density of the pulp discharge. The overflow from the top of the tank is clear water and is pumped into water-storage tank of the plant. The thickened slime is then carried by gravity launders to any one of four agitating tanks 28 feet by 16 feet, one of these being filled at a time. The slime solution in these is allowed to settle and decant by means of a special apparatus, the supernatant liquor going into a sump tank, or if of sufficient value, to an intermediate tank of about the same size as the sump tank before referred to. The slime in the agitation tank is then treated with cyanide solution, settled, and decanted. The supernatant liquor is again allowed to go into the intermediate tank and from there directly to the zinc boxes. In leaching the slimes in the agitating tanks, the contents are thoroughly stirred by means of a mechanical agitator. The resulting slime product, after treatment and settling to a proper consistency, is conveyed by means of a centrifugal pump to a stock tank of about the same size as the agitating tanks, this acting as a reservoir or receiver for the product to be filtered, where it can be allowed to settle, and, if desired, can be decanted into a wash-water tank provided in connection with the Butters filter. From the stock tank the slime product is pumped by a suitable by-pass arrangement into the Butters filter tank containing 100 leaves. The vacuum connection is then turned on the filter and the resulting gold solution drawn through the vacuum pump and delivered to a 30′ by 8′ tank, from which it is run by gravity through the zinc boxes.

After the slimes have thus been filtered, the cakes hanging on the filter frames are removed by turning water under pressure into the vacuum pipes, which frees the cake of slime accumulation and deposits it in the bottom of the filter tank, a special gravity pressure tank being provided for this purpose. To free the filter frames more effectually a compressed-air connection is provided so that the filter leaves will be thoroughly cleaned and gotten in a satisfactory condition for the next charge. By means of a suitable valve arrangement, the same centrifugal pump is made to draw the water from a tank provided for this purpose, discharging it into the filter in order to thoroughly wash the slime product, which is then settled and decanted back into the wash-water tank, after which the discharge gates provided on the bottom of the filter tank are opened and the contained slime, whose values have been extracted, is sluiced out to the dump.

The gold solution resulting from this slime-filtering process is allowed to flow to the zinc boxes combined with that resulting from the sand treatment before described. Some of this solution, after passing through the zinc boxes, is restandardized in the sump, then pumped into the agitating tanks for retreatment of the slime products. The remainder of the solution goes to the solution restandardizing tanks before mentioned. When it is desired to clean up a zinc box, after removing the zinc shavings from the compartment, the cock at the bottom of same is opened and the gold slimes are washed through a launder to a portable receptacle which is taken directly to the clean-up room. The gold slimes are there washed in a suitable tank and decanted, and are then treated in an acid tank, from which they are drawn to a sand filter. A boiler is provided for furnishing steam for heating and agitating solutions in connection with the above operations. The resulting filtered slimes are then roasted and melted down to bullion.

THE HOMESTAKE-KING MILL.

The 25-stamp mill of the Homestake-King Consolidated Mining and Milling Company, at Rhyolite, was started up in June, 1908. The process of working the ore was devised and elaborated by the California Ore Testing Company, of San Francisco, Cal., and the mechanical features of the plant were designed by John E. Rothwell, of the Colorado Iron Works, Denver (the constructors), and William B. Milliken, of Rhyolite. The mill is driven by electric power furnished by the Nevada-California Power Company. The building is a steel structure covered with galvanized iron. The stamps weigh 1,050 pounds each and the mortars are of the Homestake narrow type without inside copper plates. It is a plate-amalgamation mill without concentrators.

From the plates the crushed sands and water flow direct to a Dorr classifier for the separation of the coarser sands from the fine or slimes. The sands or oversize from the classifier go to 2 Colorado Iron Works trunnion tube mills 45 inches in diameter by 15 feet in length, inside measurement, lined with El Oro tube-mill liners and half filled with silex pebbles. In the mills the sands are ground to a very fine product, after which they flow over another set of amalgamated copper plates to save any gold released in this regrinding.

From these plates the tube mill product is returned by a belt elevator to a second Dorr classifier for further separation of sands. This sand product is returned to a third tube mill similar to the two already spoken of and the reground product of this mill is passed over amalgamated copper plates and then returned to a third classifier. The sand product of this third classifier, a very small percentage of the whole ore, is in an extremely fine granular condition and is delivered with a strong cyanide solution through an automatic distributer to one or the other of two 50-ton sand tanks and the gold and silver values leached out, the leach or gold-bearing solution going direct to the gold tanks, thence to the zinc boxes for the recovery of the values.

The slimes or fine product floated out from the classifiers flow to 2 Dorr settling and thickening tanks. In these tanks all the solids settle to the bottom and the excess of water overflows at the top and is pumped back to a water tank above the mill for use in the stamp batteries again.

The settled product of these tanks, carrying approximately 50 per cent of moisture, is delivered to one of the 2 Hendryx agitators, in which, as soon as a charge has accumulated, cyanide solution to bring the whole to a required strength is added, and the charge is agitated from 6 to 8 hours, in which time the gold and silver values to a high percentage are dissolved and held in solution. The charge is then delivered to a storage tank, preparatory to the separation of the solution from the barren solids. This operation is accomplished in the Butters filter plant, containing about 40 standard leaves, the valuable solution going to the gold tanks and the solids, after thorough washing with weak solution and water, are discharged to the tailings dump.

The gold solution collected in the gold tanks is passed through 6 zinc boxes of 8 compartments and with a capacity for 60 cubic feet of zinc shavings each. In these the gold is precipitated and caught, and the now barren solution goes to tanks above the mill to be regenerated and used again. At suitable intervals the zinc boxes are cleaned up and the gold precipitates separated from the excess of zinc. This product is then dried, calcined, and placed in crucibles with the necessary fluxes, fused, and cast into molds, and then usually remelted and cast into the regular shaped gold bars and shipped either to the United States mint, if of sufficient fineness, or to the refineries for the separation of the gold and silver values, and in turn sent to the mint.

MILLS AT MANHATTAN.

Another plant which is sliming its whole product in tube mills is that of the Manhattan Ore Reduction and Refining Company at Manhattan, Nev. This is a 10-stamp custom plant, and is provided with plates for amalgamation before and after tube milling, a 5 by 14 foot Denver Engineering Works trunnion tube mill, centrifugal pump, agitators, and a Butters filter.

The Lemon Mill has 10 stamps, with a plate-amalgamation and cyanide plant of a daily capacity of 50 tons. Construction was started in June, 1907, and was not completed until the close of the year. The property is now in the hands of the sheriff, and was operated only a very few days.

The Chapman Canyon Mill is equipped with 1 Huntington mill, concentrator tables, and treatment of tailings by cyanide. Construction was started in August, 1907, and completed June, 1908. This will be a custom plant, and is expected to treat 40 tons of ore daily.

The Veith Mill has 5 stamps, with plate amalgamation and treatment of tailings by cyanide. Construction was commenced June 1, 1908. The mill will treat ore from the Dexter lease.

Houseworth & Mickels started the erection of a 10-stamp mill in June, 1908, and will probably treat ore from a lease on Breyfogle mine.

Water for these milling plants is pumped from the old shafts, 100 to 200 feet deep, of various mining claims.

NEW MEXICO.

By Chester Naramore.

PRODUCTION.

As reported by the mines of the Territory, the gold production of New Mexico amounted to 15,962.88 fine ounces, valued at $329,982, and the silver to 705,544 fine ounces, valued at $465,659. This represents an increase of $36,963 in gold and of 214,417 fine ounces of silver, or a total gain in value of precious metals over 1906 of $173,567.

The copper and lead productions were greatly increased, the copper output being more than one-half as large again as in 1906. On the contrary, the quantity of zinc mined in New Mexico in 1907 was equal to only a small fraction of the output for 1906.

There were 127 producing mines in the Territory in 1907, of which 23 were placer and 104 were deep mines, as compared with 71 producers in 1906, including 52 deep and 19 placer mines.

There were 219,992 short tons of ore mined in 1907, which averaged $14.64 in value per ton, as compared with 207,691 short tons mined in 1906, averaging $15.29 per ton. In 1905 the average value per ton was $16.21, and in 1904 it was $18.19. This yearly decrease in total value per ton is due to the handling of an increased tonnage of low-grade copper-bearing ore each year, especially in Grant County. The average value per ton in gold and silver for siliceous ores mined in 1907 was $13.05, as compared with $16.69 in 1906 and with $11.18 in 1905. The average recovered value per ton in precious metals increased in the copper ores from $0.69 in 1906 to $0.75 in 1907, and in the lead ores from $2.32 to $7.44, but the tonnage of lead ores showed a large falling off.

Production of gold, silver, and associated metals in New Mexico in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	14,174.80	$293,019	15,962.88	$329,982	+ 1,788.08	+ $36,963
Silver ....do....	491,127	329,055	705,544	465,659	+ 214,417	+ 136,604
Copper ....pounds..	7,028,670	1,356,533	10,990,015	2,198,003	+ 3,961,345	+ 841,470
Lead ....do....	2,987,369	170,280	3,809,881	201,924	+ 822,512	+ 31,644
Zinc....................do....	17,292,655	1,054,852	750,085	44,255	−16,542,570	−1,010,597
Total................	....	3,203,739	....	3,239,823	....	+ 36,084

The comparison made in this table shows a slight gain in the total value of all 5 metals produced during 1907, which is almost equivalent to the increased value of the gold product over that of 1906. Very large gains in the totals for copper, silver, and lead are more than balanced by the great decrease in the value of the zinc product in 1907.

Production of gold, silver, copper, lead, and zinc in New Mexico in 1907, by counties.

County.	Producing mines.	Tonnage.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ounces.*		*Fine ounces.*	
Colfax	9	....	576.34	$11,914	83	$55
Dona Ana.....................	5	6,084	.29	6	25,612	16,904
Grant.....................	50	146,746	5,468.41	113,042	224,279	148,024
Lincoln.....................	7	5,767	2,003.55	41,417	721	476
Luna.....................	9	2,048	664.72	13,741	8,633	5,698
Mora.....................	2	632	82.43	1,704	1,404	927
Rio Arriba.....................	1					
San Miguel.....................	1					
Taos.....................	1					
Otero.....................	11	12,203	716.48	14,811	2,135	1,409
Santa Fe.....................	8	21,338	869.74	17,979	17,635	11,639
Sierra.....................	11	700	397.84	8,224	2,250	1,485
Socorro.....................	12	24,474	5,099.98	105,426	422,744	279,011
Unapportioned.....................	....	....	83.11	1,718	48	31
Total................	127	219,992	15.962.88	329,982	705,544	465,659

Production of gold, silver, copper, lead, and zinc in New Mexico in 1907, by counties—Continued.

County.	Copper.		Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Colfax							$11,969
Dona Ana	776,125	$155,225	675,189	$35,785			207.920
Grant	8,046,315	1,609,263	1,394,390	73,903	73,729	$4,350	1,948,582
Lincoln							41,893
Luna			1,022,773	54,207			73,646
Mora Rio Arriba San Miguel Taos	62,765	12,553					15,184
Otero	679,480	135,896					152,116
Santa Fe	1,231,260	246,252					275,870
Sierra	5,425	1,085	9,548	506			11,300
Socorro	188,645	37,729	707,981	37,523	676,356	39,905	499,594
Unapportioned							1,749
Total	10,990,015	2,198,003	3,809,881	201,924	750,085	44,255	3,239,823

Tonnage of ore sold or treated, number of deep mines producing, by counties, and average value per ton of ore mined in New Mexico in 1906 and 1907.

County.	Short tons of ore sold or treated.		Number of deep mines producing.	
	1907.	Increase (+) or decrease (−).	1906.	1907.
Dona Ana	6,084	−10,136	4	5
Grant	146,746	+18,946	21	45
Lincoln	5,767	− 613	2	7
Luna	2,048	+ 54	8	9
Mora, Rio Arriba, San Miguel, and Taos	632	+ 531	2	5
Otero	12,203	+11,935	3	10
Santa Fe	21,338	+21,210	2	3
Sierra	700	− 2,546	5	8
Socorro	24,474	−27,080	5	12
Total	219,992	+12,301	52	104
Average value per ton			$15.29	$14.64

The substantial increases in the tonnage mined in Grant, Otero, and Santa Fe counties are all of copper-bearing ores, and in the two last-mentioned counties result from operating local smelters during some portion of 1907. The decreases in tonnage shown in Socorro and Dona Ana counties represent lesser quantities mined of zinc and lead ores, respectively.

New Mexico furnished no new gold and silver producing districts during 1907, but renewed activity was evident in a number of old-established sections, and the increased gold and silver production was derived, in a large measure, as a by-product in the handling of greater quantities of copper ore and copper-bearing siliceous ores, and to a less degree, of lead ore. In Lincoln County the increase of precious metals resulted from working old mines.

Number of mines in New Mexico, classed by chief product, in 1907, by counties.

County.	Gold placer mines.		Deep mines.								Total mines producing.
	Hydraulic.	Surface placers.	Gold.	Silver.	Copper.	Gold-silver.	Gold-silver-copper.	Silver-copper.	Silver-lead.	Lead-zinc.	
Colfax	3	6									9
Dona Ana					1			1	3		5
Grant		5		[a] 3	7	3	17	[b] 8	6	[c] 1	50
Lincoln				1		6					7
Luna			[d] 1						[e] 8		9
Mora					2						2
Otero		1			[f] 6		3	1			11
Rio Arriba							1				1
San Miguel					1						1
Santa Fe	1	4			[g] 2		1				8
Sierra		3	2	1		2	1	1	1		11
Socorro					2	3	1	1	1	[c] 4	12
Taos						1					1
Total	4	19	3	5	21	15	24	12	19	5	127

[a] 1 silver-copper-lead mine.
[b] 2 silver-copper-lead mines.
[c] 1 zinc mine.
[d] 1 gold-lead mine.
[e] 2 gold-silver-lead mines.
[f] 2 gold-copper mines.
[g] 1 gold-copper mine.

This table reveals the fact that the increase in the total number of producing deep mines was largely caused by the operating of a greater number of copper-producing properties during the time that the price of that metal was so high in 1907. Thus the copper mines increased from 9 to 43 and the silver-copper mines from 4 to 8, and there were 2 gold-silver-copper mines producing in 1907, as compared with 5 in 1906. This makes a gain of 35 mines which produce copper as a chief product out of a total increase of 52 deep mines.

Thirteen counties report a production in 1907, as against 10 in 1906. Mora, Rio Arriba, and Taos counties each made some production during the year.

GOLD.

Source of gold production in New Mexico by kinds of ore in 1907, by counties, in fine ounces.

County.	Placer mines.	Deep mines.			Total.
		Dry or siliceous ores.	Copper ores.	Lead ores.	
Colfax	576.34				576.34
Dona Ana				0.29	.29
Grant	182.96	4,565.24	720.21		5,468.41
Lincoln		2,003.55			2,003.55
Luna				664.72	664.72
Mora, Rio Arriba, San Miguel, and Taos		2.42	80.01		82.43
Otero	4.84		711.64		716.48
Santa Fe	59.53	13.16	797.05		869.74
Sierra	28.78	369.06			397.84
Socorro		5,081.35	18.00	[a] .63	5,099.98
Unapportioned	83.11				83.11
Total	935.56	12,034.78	2,326.90	665.64	15,962.88
Total, 1906	1,296.81	12,485.97	364.98	27.04	14,174.80
Increase (+) or decrease (−)	−361.25	−451.18	+1,961.92	+638.60	+1,788.08

[a] From lead-zinc ore.

The value of the gold product of the mines of New Mexico for 1907 was greater by $36,963 than in 1906. There was more than 6 times as much gold produced from copper ores and almost 25 times as much gold from lead ores as in 1906. The value of the gold contained in copper ores increased $40,557, and amounted to nearly 15 per cent of the total value of the gold production, while in 1906 it composed less than 3 per cent of the total production. The increase of gold values in lead ores amounted to $13,201. The gold recovered from siliceous ores was less by $9,327 than in 1906, yet this class of ore was the source of over three-fourths of the gold output of New Mexico in 1907.

The placer gold output decreased $7,468 in value. In Grant County there was an increase of gold derived from siliceous ores and from copper ores. The increased tonnage of copper ores mined in Otero and Santa Fe counties (due to the operation of local smelters in 1907 in these counties) accounts for the larger gold figures. Greater quantities of siliceous ores in Lincoln County and of lead ores in Luna County made the gold output larger.

Smaller placer returns in Colfax and reduced savings from placers and from siliceous ores in Sierra County, resulted in a decreased gold output from these counties as compared with that of 1906.

In Socorro County there was a greater tonnage of siliceous ore mined, but less gold was recovered therefrom.

There will probably be a smaller gold output from the mines of New Mexico in 1908 than there was in 1907, due to the mining of less gold-bearing copper and lead ores. This prediction is based upon the fact that some of the local smelters of the Territory were idle during the first half of the year while the metal prices were low.

SILVER.

Source of silver production in New Mexico, by kinds of ore, in 1907, by counties, in fine ounces.

County.	Placer mines.	Deep mines.				Total.
		Siliceous or dry ores.	Copper ores.	Lead ores.	Lead-zinc ores.	
Colfax	83					83
Dona Ana			7,795	17,817		25,612
Grant	27	138,742	68,767	16,743		224,279
Lincoln		721				721
Luna				8,633		8,633
Mora, Rio Arriba San Miguel and Taos		4	1,400			1,404
Otero			2,135			2,135
Santa Fe	9		17,626			17,635
Sierra	6	1,947	97	200		2,250
Socorro		400,838	17,503	2,000	2,403	422,744
Unapportioned	48					48
Total	173	542,252	115,323	45,393	2,403	705,544
Total, 1906	195	304,917	118,548	64,882	2,585	491,127
Increase (+) or decrease (−)	−22	+237,335	−3,225	−19,489	−182	+214,417

The large gain in the total quantity of silver mined in 1907 as compared with 1906, as shown in the table, resulted from increased quantities of siliceous ores in Grant and Socorro counties, and of copper ore in Dona Ana, Otero, Santa Fe, and Socorro counties. Smaller quantities of silver were contained in the lead ores mined in Dona Ana, Grant, and Luna counties during 1907. Silver was the sole chief product in the output of 7 mines in 1907, and was one of the chief products in 4 gold and silver mines, in 2 gold, silver, and copper mines, and in 8 silver-copper mines; but silver occurred as a greater or lesser value in the product of 88 out of a total of 127 producing mines in 1907.

COPPER.

The copper output of the mines of New Mexico in 1907 increased nearly 4,000,000 pounds as compared with that of 1906, making a total of 10,990,015 pounds, with a value of $2,198,003. Thus the large copper increase, coupled with the decrease in zinc production in 1907, makes the value of the copper mined that year more than double the combined values of the other 4 metals.

Grant County, the source of 6,338,830 pounds, or 91 per cent of the copper production of the territory in 1906, increased its total output to 8,046,315 pounds, which is 73 per cent of New Mexico's total for 1907. Other increases are: In Santa Fe County, from 2,119 pounds to 1,231,260 pounds; in Dona Ana County, from 434,000 pounds to 776,125 pounds; in Otero County, from 133,166 pounds to 679,480 pounds, and in Socorro County, from 64,560 pounds to 188,645 pounds.

A notable feature of the increased tonnage is the gain in the number of producing mines. Many small properties were able to produce ore while the prices of metals were favorable in the earlier part of the year, and the several smelters in the Territory were in operation.

LEAD.

The mine production of lead in New Mexico in 1907 increased 822,512 pounds as compared with that of 1906, and amounted to 3,809,881 pounds, with a value of $201,924. This is a gain of more than one-fourth over the production of 1906 and is equivalent to more than 2½ times the output for 1905.

The lead output increased in the different counties as follows: In Grant County, 683,495 pounds; in Luna County, 191,580 pounds; in Sierra County, 9,548 pounds, and in Socorro County, 469,893 pounds. In Dona Ana County there was a falling off of 532,004 pounds. The value of the lead product in New Mexico in 1907 was about one-sixteenth of the total value of all five metals.

ZINC.

The annual zinc output of New Mexico increased steadily during the last few years, until 1907, when the mine production suddenly dropped from 17,292,655 pounds in 1906 to 750,085 pounds in 1907, a decrease in quantity of 16,542,570 pounds, and in value of $1,010,597.

The output of Socorro County, the source of over 98 per cent of the zinc production of New Mexico in 1906, fell off 16,367,807 pounds. This was caused by the largest producers of the Magdalena district either making no production at all, or a very small one, incidental to development work.

Grant and Luna counties also record large proportionate decreases in zinc totals.

SMELTERS.

The El Paso smelter continued to handle a good portion of the ores from the mines of New Mexico during 1907. In Arizona, the Copper Queen smelter, at Douglas, and the Shannon smelter, at Clifton, also received copper ores from the southwestern counties of New Mexico .

At Silver City, in Grant County, the Comanche Mining and Smelting Company operated its plant upon ores from the surrounding districts, until December, 1907, when it was placed in the hands of a receiver.

A new concern, the Southwest Smelting and Refining Company, blew in its 250-ton copper furnace at Oro Grande, Otero County, on November 6, and ran successfully the remainder of the year. The Santa Fe Gold and Copper Company operated its 125-ton matting plant at San Pedro from February 10 to October 1, 1907. This plant had been idle for several years previous to 1907.

The only active lead smelter within the Territory during 1907 was the plant at Deming, in Luna County, which was formerly operated by the Luna Lead Company, and is now merged with the National Mining and Smelting Company.

In Socorro County the Mistletoe Mining Company has a 50-ton zinc smelter at Kelly.

Subdivision of tonnage of ore sold or treated in New Mexico in 1907, by counties, in short tons.

County.	Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Lead-zinc ores.	Total.
Colfax						
Dona Ana		5,208	876			6,084
Grant	21,832	[a]122,830	1,929	155		146,746
Lincoln	5,767					5,767
Luna			2,048			2,048
Mora, Rio Arriba, Taos, and San Miguel	3	629				632
Otero		12,203				12,203
Santa Fe	10	21,328				21,338
Sierra	676	4	20			700
Socorro	18,198	2,647	1,000	250	2,379	24,474
Total	46,486	164,849	5,873	405	2,379	219,992
Total, 1906	27,724	126,330	19,001	34,636		207,691
Increase (+) or decrease (−)	+18,762	+38,519	−13,128	−34,231	+2,379	+12,301
Average recovered value per ton in gold and silver	$13.05	$0.75	$7.44		$0.67	$3.53

[a] Includes 6,404 tons copper-lead ore.

REVIEW BY COUNTIES.

No shipments were reported from Bernalillo or Chavez counties in 1907, but in the latter county, at Roswell, some ore was extracted in development work done by the Old Governors Copper Mining and Smelting Company.

COLFAX COUNTY.

As in 1906, 9 placer mines furnished the entire precious metal output, which fell off in total value from $14,554 in 1906 to $11,969 in 1907. There were produced 576.34 fine ounces of gold, valued at $11,914, and 83 fine ounces of silver, valued at $55. The Moreno district, about Elizabethtown, was the source of almost three-fourths of the production, and the balance was won in the Ute Creek district, about Baldy.

Development work was reported from the following deep mines: The Highland Mary mine, in the Ponil district; the Legal Tender mine, in the Willow Creek district, and the properties of the Gold and Copper Deep Tunnel Mining and Milling Company, in the Moreno district. The latter company is driving a tunnel, which is now in 2,500 feet.

DONA ANA COUNTY.

Production of gold, silver, and associated metals in Dona Ana County, N. Mex., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..................fine ounces..	....	....	0.29	$6	+ 0.29	+ $6
Silver ....do....	34,051	$22,814	25,612	16,904	− 8,439	− 5,910
Copper ....pounds..	434,000	83,762	776,125	155,225	+342,125	+71,463
Lead ....do....	1,207,193	68,810	675,189	35,785	−532,004	−33,025
Total..........................	....	175,386	....	207,920	....	+32,534

There was a decreased production of silver and lead in Dona Ana County in 1907, but the increased copper output raised the total value of all metals from $175,386 in 1906 to $207,920 in 1907. Five mines shipped 6,084 tons of ore, as compared with 4 mines shipping 16,220 tons in 1906. The Organ district, including Organ and Kent, was the only producing section of the county during 1907.

Among the producing properties, the Torpedo and the Memphis mines shipped copper ores carrying silver values; and lead ores carrying silver values were shipped from the Dona Ana, Modoc, and Stephenson-Bennett groups. The Memphis Copper Company has a 175-foot shaft and a 200-foot tunnel. The Stephenson-Bennett Consolidated Mining Company's workings include a 300-foot shaft, a 2,000-foot tunnel, and 3,000 feet of drifts, and the surface equipment includes a 50-ton concentrating mill.

The Mormon Mining and Milling Company, the Schermerhorn Mining Company, and the Victoria Mining Company all report development work for 1907.

GRANT COUNTY.

Production of gold, silver, and associated metals in Grant County, N. Mex., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold ....fine ounces..	4,828.25	$99,809	5,468.41	$113,042	+ 640.16	+$13,233
Silver....................do....	163,987	109,871	224,279	148,024	+ 60,292	+ 38,153
Copper ....pounds..	6,388,830	1,233,044	8,046,315	1,609,263	+1,657,485	+376,219
Lead ....do..	710,895	40,521	1,394,390	73,903	+ 683,495	+ 33,382
Zinc.........................do..	144,656	8,824	73,729	4,350	− 70,927	− 4,474
Total..................	....	1,492,069	....	1,948,582	....	+456,513

The position of Grant County among the other counties of New Mexico as a mineral producer during 1907 is best shown by a few comparisons. In 1907 three-fifths of the total value of the 5 metals dealt with in this report and produced in New Mexico was derived from the mines of Grant County, which furnished approximately one-third of the gold, silver, and lead, three-fourths of the copper, and one-tenth of the zinc mined in the Territory. It ranked first among the counties in the production of gold, copper, and lead, and second to Socorro County in the production of silver and zinc.

The county's increases in 1907 were: In gold, $13,233; in silver, 60,292 fine ounces; in copper, 1,657,485 pounds, and in lead, 683,495 pounds. This latter is almost double the lead product of 1906. The zinc output fell off about one-half, and was only 73,729 pounds for 1907.

The increase of the county in total value was almost one-third over that of 1906, and amounted to $456,513. The tonnage gained 18,946 short tons, a total of 146,746 tons.

The siliceous ores increased from 1,903 tons in 1906 to 21,832 tons in 1907. (Most of this ore carried a low percentage of copper, but not enough to be classed as copper ore.) The copper ores remained almost constant in quantity, with 122,830 tons in 1907, as compared with 122,752 tons in 1906. Both the lead and the zinc ores show decreases, but the total tonnage of these 2 classes of ores is too small to affect the county totals to any great extent.

The large gain in the number of producing deep mines (from 21 to 45) resulted from the working of many small properties during a portion of the year when conditions were extremely favorable, with the prevailing high metal prices, and a local market at the Comanche smelter at Silver City.

The gold-silver-copper mines increased in number from 8 to 17 and the silver-copper mines from 1 to 8. There were 5 active placer mines, 1 more than in 1906; and the gold from placer mines increased from 110.78 fine ounces, valued at $2,290, in 1906, to 182.96 fine ounces, valued at $3,782, in 1907. The gold mined in siliceous ores increased from 4,363.47 fine ounces in 1906 to 4,565.24 fine ounces in 1907, and the copper ores contained 720.21 fine ounces of gold in 1907, as compared with 346.94 fine ounces in 1906.

The silver product was raised from 163,987 fine ounces in 1906 to 224,279 fine ounces in 1907, a gain of nearly 37 per cent. More than 5 times (138,742 fine ounces) as much silver was mined in siliceous ores in 1907 as in 1906 (27,270 fine ounces). The silver content of the copper ores decreased from 117,030 fine ounces in 1906 to 68,767 fine ounces in 1907, and the lead ores furnished 2,893 fine ounces less than in 1906.

The copper output of Grant County increased from 6,388,830 pounds, valued at $1,233,044, in 1906 to 8,046,315 pounds, valued at $1,609,263, in 1907. Thus the copper product of this county formed approximately one-half of the total value of the output of all 5 metals in New Mexico in 1907.

The very large increase in the lead output, from 710,895 pounds in 1906 to 1,394,390 pounds in 1907, places Grant County in the first rank as a lead producer, instead of third to Dona Ana and Luna counties, as in former years. While the lead output increased nearly one-half, the zinc production fell off one-half and amounted to only 73,729 pounds, valued at $4,350 in 1907.

MINES REVIEW.

Apache district.—In the Apache district, southeast of Hachita, shipments of argentiferous copper ore were made from the Apache mine during the first half of 1907, and during the last half of the year the mine was being developed by the Anderson-Apache Copper Company. The ore is oxidized and occurs in a very coarse crystalline limestone.

Burro Mountain district.—The Burro Mountain district, southwest of Silver City, made a reduced output, but it was the center of some very extensive development work, which assures this section of being one of New Mexico's permanent copper camps. The ores are of low grade but occur in large bodies. Most of the mineral area of this section has been consolidated into the holdings of 4 large companies.

The Burro Mountain Copper Company, at Leopold, the largest producer of the district, has developed its property by vertical and incline shafts averaging 250 feet in depth and by approximately 8,000 feet of drifts and crosscuts. The ore is concentrated in a 300-ton plant before shipment.

The Copper Gulf Development Company made some shipments from its Virginia mine of oxidized ores extracted while doing development work, which includes a 300-foot vertical shaft and 2,000 feet of drifts. This company made extensive additions to its holdings by purchasing much surrounding territory during 1907.

The Chemung Copper Company's properties include 30 claims. At present development work is being carried on through 3 vertical shafts, respectively 550, 525, and 400 feet deep, and amounts to about 1,000 feet per month.

The Comanche Mining and Smelting Company also holds a large number of claims in this district.

Central district.—Fifteen mines (some of them small) reported a production from the Central district, as compared with 8 mines in 1906, and the total output was much larger. The Santa Rita Mining

Company, New Mexico's greatest copper producer, still further increased its tonnage and copper output in 1907. Underground workings, including shafts, drifts, and crosscuts, amount to about 30,000 feet. Part of the ore is shipped crude and part is handled in an 80-ton wet concentrating plant. The Copper Queen Company, at Fierro, operated the Hanover, Modoc, and Engineer mines.

The Hermosa Copper Company made greatly increased shipments of argentiferous copper-lead ore from its properties in Hanover Gulch, principally from the Ivanhoe mine. The Philadelphia Copper Company and the Hanover Bessemer Iron Association shipped ore derived from extensive development work. There were shipments of lead ore made from the Lucky Bill mine, and of zinc carbonate ore from the Empire Zinc Company's mines at Hanover.

Chloride Flat district.—There were more active mines and increased shipments of siliceous silver ore and silver-lead ore from this district in 1907 than in 1906. The chief producers were the Baltic, Gold Coin, Grand Central, and Providence mines. The production was 5,159 tons of ore and a value of $30,863 in gold, silver, and lead.

Eureka district.—There was renewed activity and a larger production in the Eureka district, southwest of Hachita. Shipments were made from the Copper Dick group, the Hornet mine, and the King mine, the latter operated by the Mariposa Mining Company.

Pinos Altos district.—This district furnished about the same quantity and grade of ore in 1907 as in 1906. The largest operator was the Comanche Mining and Smelting Company. A 500-ton concentrating mill was erected by this concern at its smelter at Silver City, but after about one month's run, in May, 1907, it was placed out of commission. The copper matting furnace was operated until November 6, when the company went into the hands of a receiver. The production of the district was 14,841 tons and $78,723 in gold, 65,835 fine ounces of silver, and 322,195 pounds of copper, the total value for 1907 being $186,613.

The Forest Queen mine reports that a large tonnage of copper-zinc ore carrying some precious metal values has been blocked out.

Red Hill district.—There was an increased output of oxidized lead-silver ore from the Red Hill or Gillespie district, in the southwest corner of the county.

Steeple Rock District.—The Laura mine shipped a highly siliceous ore, carrying gold and silver, to the smelters at Douglas and Clifton, where it was used for converter lining.

Steins Pass district.—Much smaller shipments were made from the San Simon and from the Kimball districts, near Steins Pass.

Lordsburg section.—There was greatly increased activity in 1907 in the Pyramid district, 8 miles south of Lordsburg. Silver ore carrying a low percentage of copper and lead was shipped from the dump of the Venus mine, one of the old mines of the district. The North American Copper Company made increased shipments of silver-bearing copper ore from the Nellie Bly mine.

Likewise, there was a much larger output of copper ore carrying gold and silver values from the Virginia district, 4 miles southwest of Lordsburg. The Superior mine, the Miser's Chest, and the Lone mines (the latter operated by the Bonnie Mining Company) include the principal producers.

LINCOLN COUNTY.

With 7 deep mines operating in 1907 the gold production of Lincoln County increased from $16,463 in 1906 to $41,417 in 1907, but the silver output fell off from 1,946 fine ounces to 721.

The production in 1906 was confined to the Bonita and Whiteoaks districts, but 3 additional districts contributed to the production of 1907, namely, the Cedar Creek, the Jarilla, and the Nogal districts.

Bonita district.—At the Parsons mine, of the Hopeful group, the Eagle Mining and Improvement Company has remodeled its mill from a plate-amalgamating to a straight cyanide process, with a capacity of 200 tons. The gold occurs in a kaolinized porphyry and is mined by open cuts.

Cedar Creek section.—In the Cedar Creek section, about Alto, at the Virginia-Commercial group, ore extracted in doing development work was stored on the dump.

Jicarilla district.—The active properties in this section include the Gold Luck, the Wisconsin, and the Honey Bee groups. The latter is a copper prospect.

Nogal district.—The Vera Cruz Mining Company's ore is a low-grade conglomerate, the values occurring as free gold in the interstices of the conglomerate. Amalgamation was not as successful as was anticipated, and a cyanide mill is planned.

Whiteoaks district.—A much larger production was reported from the Whiteoaks district in 1907 than in 1906. At the Old Abe mine, the main shaft was sunk to the 1,420-foot level during 1907, and the only ore extracted resulted from the opening up of this new level.

LUNA COUNTY.

Luna County's mineral production was largely a lead production, as lead values amounted to $54,207, or three-quarters of the value of $73,646 of the total mineral output of the county. Luna County ranks second only to Grant County as a producer of this metal. Nine mines furnished 2,048 short tons of lead ore in 1907, as compared with 8 mines and 1,994 tons in 1906. The working of a mine which was inoperative in 1906 is largely responsible for the great increase of the gold figures from $413 in 1906 to $13,741 in 1907. A smaller quantity of silver was reported, and the zinc output dropped off entirely during 1907. The lead increased 191,580 pounds, and totaled 1,022,773 pounds.

Cooks Peak district.—This district was the most active in the county, and was the source of the larger portion of the production of the county, and contained 6 of the 9 producing mines. These were the Desdemona, Inez, Faywood, Lead King, Summit, and White Oaks mines, and their total production was valued at $47,225 in gold, silver, and lead.

Florida district.—A reduced production was reported from the Lead Carbonate and Soledad mines in this district, but development work placed ore on the dump at other properties.

Victoria district.—The Rambler mine, in the Victoria district, made an increased production as compared with that of 1906 of lead-carbonate ores carrying precious metal values.

MORA COUNTY.

Two small copper mines made trial shipments from Mora County during 1907. The Republic Mines Company, at Lucero, was erecting a 40-ton furnace to reduce its own ores. The Overton mine in the Coyote district, about Guadalupita, has a 342-foot vertical shaft and a 312-foot tunnel.

OTERO COUNTY.

The total value of the mineral product of Otero County increased sixfold in 1907 and amounted to $152,116. Nine-tenths of this total, or $135,896, represents the value of the copper mined. Ten deep mines furnished 12,203 short tons of copper ore, most of which contained small gold and silver values, as compared with 3 deep mines and 268 short tons in 1906. Gold increased from $423 to $14,811 in 1907 and the silver from 533 fine ounces to 2,135 fine ounces. The placer gold output was but half as large as in 1906.

Silver Hill district.—The largest increases in production centered around the operations of the Southwest Smelting and Refining Company. This concern completed its smelting works at Oro Grande and started the 250-ton matting furnace during the first week of November. This furnished a near market for the many small mines and prospects in the Jarilla Range, as well as for the company's own holdings, including the Lucky, By Chance, Nannie Baird, Iron Mask, Iron Queen, and other mines which the company has been developing for two years past. Shipments were also made from the Delusion, Monarch, Providence, Lincoln, and Garnet mines. This district furnished 8 out of 10 producing deep mines in Otero County during 1907.

The Electric Mining and Milling Company transferred its holdings to the Texas-Jarilla Placer Mining Company, which company spent the year in erecting a milling plant, which went into commission on February 1, 1908.

Tularosa district.—The Tularosa Copper Company shipped crude ore and concentrates from the Virginia mine during the first half of 1907, and spent the last half of the year in developing the mine and remodeling its surface equipment.

The Three Rivers Mining Company, operating in the White Mountain section in the extreme northern end of the county, has placed some gold and silver bearing copper ore on the dump in the course of the year's development work.

RIO ARRIBA COUNTY.

Rio Arriba County is again listed among the producing counties after two years of nonproduction.

The Las Tusas Mining and Milling Company, of Tres Piedras, shipped copper ore carrying small precious metal values from both the Tampa and the Whale mines in the Bromide district. In the Hopewell section the Dixie Queen Mining Company has sunk a 115-foot vertical shaft in developing a deep placer, and the King William Company has been hydraulicking out a big cut in order to reach pay gravel.

SANDOVAL COUNTY.

In Sandoval County development work was carried on in the Cochiti gold district, about Bland, in the northeast corner, and at the copper deposits about Placitas, in the southeast corner of the county.

SAN MIGUEL COUNTY.

The Tecolote Consolidated Copper Company, of Chapelle, leached some low-grade copper ore in its 100-ton plant, using a dilute solution of sulphuric acid and precipitating by electrolysis, but the drop in the price of copper in the latter part of 1907 caused the company to cease operations.

Ore extracted in doing development work by the Pecos Copper Company at Cowles is being stored on dumps until reduction works are built.

SANTA FE COUNTY.

In 1907 the mineral output of Santa Fe County was derived from 5 placers and 3 deep mines, as against 3 placers and 2 deep mines in 1906. Excepting one small operator at Cerrillos, the placer product was won from the mines in the New Placers district, about Golden, and amounted to only $1,231 in gold and 9 fine ounces in silver.

The lode mine output shows a very great gain in 1907, owing to the operation of the smelter at San Pedro after an idleness of several years.

Most of the precious metal values from deep mines were by-products from the mining of copper ores, and amounted to $16,748 in gold with 17,626 fine ounces of silver. The copper production amounted to 1,231,260 pounds, valued at $246,252, equal to almost nine-tenths of the total value of the mineral product of the county. Santa Fe County ranks second only to Grant County as a source of copper during 1907.

The Santa Fe Gold and Copper Company resumed operations at its mine in December, 1906, and the matting furnace was blown in on February 10, 1907, and produced until October 10, when the price of copper did not warrant a continuance. According to a printed report, a 60-per cent matte was produced and the average yield per ton smelted was 57.4 pounds of copper, 0.8275 ounce of silver, and 0.0369 ounce of gold. Mine development was continued after the closing of the reduction works.

Small productions were made at the Gold Queen and the Gold Coin mines in the New Placers district, and development work in the Cerrillos district placed some lead-zinc ore on the dumps.

SIERRA COUNTY.

The mineral production of 1907 in Sierra County again shows very large decreases in tonnage and in all the metals except lead, which made the slight increase of 9,548 pounds. The total value of the county's product in 1907 was $11,300, as compared with $24,633 in 1906 and $111,613 in 1905.

In this county gold values predominate and a portion of the decreases are accounted for in the large falling off in placer output, caused by the idleness of the 2 larger companies. The placer returns for 1907 result from small intermittent operations by a number of individuals. Although the shipments from deep mines show a great falling off as compared with those of 1906, 3 more mines reported a production in 1907, but in nearly every case the shipments were incidental to development work.

Black Range district.—At the Keystone mine at Kingston, silver ore, taken from the dump, was concentrated in the 30-ton mill, and the product was shipped to the smelters. Small shipments of lead ore carrying silver and copper values were made from the Miner's Dream group.

Cuchillo Negro district.—Copper ore carrying silver and lead values was shipped from the Black Knife group, at Fairview.

Las Animas district.—A large portion of the county's small production in 1907 was won from the Hillsboro section, but here, too, there was less activity at the mines than in former years. The Empire Gold Mining and Milling Company shipped concentrates and crude ore, carrying gold, silver, and some copper values, in addition to making a bullion saving by amalgamation. The Ready Pay Reduction Company made 2 mill runs late in the year. The equipment includes 2 Huntington amalgamating mills and concentrating tables. Other active properties include the San Antonio and Sophia mines and the Garfield and Ben Butler mines. The latter is being developed by tunnels.

SOCORRO COUNTY.

Production of gold, silver, and associated metals in Socorro County, N. Mex., in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold............fine ounces..	6,187.52	$127,907	5,099.98	$105,426	− 1,087.54	−$22,481
Silver....................do....	271,082	181,625	422,744	279,011	+ 151,662	+ 97,386
Copper ....pounds..	64,560	12,460	188,645	37,729	+ 124,085	+ 25,269
Lead ....do....	238,088	13,571	707,981	37,523	+ 469,893	+ 23,952
Zinc ....do....	17,044,163	1,039,694	676,356	39,905	−16,367,807	−999,789
Total..................	....	1,375,257	....	499,594	....	−875,663

The mines of Socorro County produced greater quantities of silver, copper, and lead and less quantities of gold and zinc in 1907 than in 1906. The county's decrease in the value of the zinc production amounted to almost $1,000,000. The county ranks second to Grant in the total value of its mineral output and in the production of gold, but still holds first place as a producer of silver and zinc. The silver production almost doubled, and amounted to nearly three-fifths of the total silver output of the Territory.

Cooney district.—The Cooney (or Mogollon) district, in the southwest corner of the county, furnished most of the tonnage of copper ore and all of the siliceous ore. The production of siliceous ore increased from 16,076 short tons in 1906 to 18,198 tons in 1907, and was the source of nearly the entire gold and silver output in 1907.

The principal producing mine of the Mogollons is the Last Chance, of the Ernestine Mining Company, at Mogollon. The mine development at the end of 1907 amounted to 6,049 feet of levels, 490 feet of crosscuts, and 1,074 feet of shafts and raises. The ore is reduced in a 20-stamp mill, having a capacity of 60 tons a day. Concentration is followed by cyanide treatment. The concentrates are hauled 90 miles by wagon to Silver City and then shipped to the El Paso smelter.

The Cooney, or Silver Bar, mine resumed shipments of concentrates to El Paso. A copper ore carrying fair silver values and small gold values is concentrated by means of rolls, Huntington mills, Wilfley tables, and Frue vanners. The mine is opened by a 760-foot shaft and a 900-foot tunnel, and has 9 levels.

Development work was continued at the Enterprise mine in 1907, and a cyanide plant is to be erected during 1908.

Ore extracted in doing development work was left on the dump at the Top mine and at the Hoosier-Trilby-Extension properties.

Magdalena district.—All of the zinc and lead and a portion of the copper and silver produced in the county in 1907 were mined in this section. The lead output increased from 238,088 pounds in 1906 to 707,981 pounds in 1907. The great decrease in the quantity of zinc produced (from 17,044,163 pounds to 676,356 pounds) deprived the district of its main asset. The figures would lead one to believe that this section was devoid of mining activity during 1907, but such was not the case, as a large amount of development work and many surface improvements were being undertaken by the larger mines.

The principal producers during 1907 include the operators of the Graphic group, the Key group, the Juanita, the South Juanita, and the properties of Daniel de Gracia.

The Kelly mine, of the Tri-Bullion Smelting and Development Company, was the source of a large portion of the zinc output of the district during 1906, but made no shipments of ore in 1907. A new surface plant was installed and 2,783 feet of development work was done during the year. The Mistletoe Mining Company also spent the entire year in development work and found a new ore body of somewhat lower grade, said to occur as a mineralization of a basic dike instead of a replacement of limestone, as in the previously exposed occurrences.

Oscura district.—This district, about Estey City, in the southeastern corner of the county, produced some small shipments of copper ore which were taken out in doing prospect work.

The Dividend Mining and Milling Company operated its leaching plant for about five months and produced some cement copper.

Rosedale section.—No production was reported from the Rosedale section, but development work was carried on by the New Golden Bell Mining Company, the Ninety-Nine Mining Company, and the White Cap Mining Company.

TAOS COUNTY.

Mining activity in Taos County, with the exception of that by 1 producing mine, was confined to development work in the vicinity of Red River and Twining. The La Grange Gold Mining Company was installing a dredge at Tres Piedras.

UNION COUNTY.

The Fort Pit Copper Company, operating in the Black Mesa district, in the extreme northeast corner of the Territory, reports that it plans to erect a matting furnace during 1908.

OREGON.

By Charles G. Yale.

PRODUCTION.

From Oregon, during the calendar year 1907, producing mines to the number of 206 reported, of which 65 were quartz and 141 placers. The combined yield of these mines was $1,297,316. Of this total the gold output was 54,628 ounces, valued at $1,129,261, and the silver 86,718 ounces, valued at $57,234, the total value of the two metals being $1,186,495. This is $233,567 less than the value of the 1906 product of these two metals, the falling off being altogether in the gold, viz, $237,639. The silver yield itself increased $4,072. In total quantity of ore mined, the siliceous ore showed a decrease of 32,694 tons and the copper ore an increase of 5,118 tons, a total decrease of 27,576 tons. This decrease in tonnage naturally brought about a decrease in output of the quartz mines for the year, which amounted to $207,485 in gold alone. The placer mines also decreased their gold yield by $30,154. Copper ore increased from 1,942 tons in 1906 to 7,060 tons in 1907, an increase of 5,118 tons. This increase is more apparent than real, however, for the reason that by an oversight certain tons of matte were mistaken for tons of ore in one instance in the figures of 1906. The real increase was 3,275 tons.

The average value of siliceous ore in gold and silver per ton in 1907 was $8.08, and of copper ores in gold and silver, $2.23. During 1907 there were treated at gold and silver mills 93,489 tons of ore, containing $685,649 in gold and $43,957 in silver. In milling the ores $443,022 in gold and $11,283 in silver were recovered by ordinary plate amalgamation, the average being $4.78 gold and 12 cents silver per ton. The concentrates saved from this ore were in quantity 4,400 tons, valued at $242,627 in gold and $32,674 in silver, or an average of $55.14 in gold and $7.43 in silver. The average extraction in gold and silver mills, including the values saved, both by amalgamation and in the concentrates, was $7.33 per ton gold and 47 cents silver, a total of $7.80 in gold and silver. Crude ore shipped to smelters amounted to 8,233 tons, valued at $112,206 in gold and $11,435 in silver, an average of $13.63 in gold and $1.39 in silver per ton. The smelter ore includes also the value of gold and silver in the copper ores. There were 8,976 tons of tailings treated, bullion contents of which are included under mill bullion.

The statement of production of 1906 and 1907 showing increase and decrease and valued at each year's average commercial prices is as follows:

Production of gold, silver, and associated metals in Oregon in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		
1906	66,123.79	$1,366,900	79,346	$53,162	415,803	$80,250	$1,500,312
1907	54,628	1,129,261	86,718	57,234	554,104	110,821	1,297,316
Increase (+) or decrease (−)	−11,495.79	−237,639	+7,372	+4,072	+138,301	+30,571	−202,996

The production of ore in Oregon in 1907 was 110,698 short tons, having an average value in gold and silver of $11.72 per ton, against 138,274 short tons in 1906, having an average value of $10.85 per ton, a decrease in 1907 of 27,576 tons in quantity and an increase of 87 cents in average value per ton.

GOLD.

The total gold output of Oregon in 1907 was 54,628 fine ounces, valued at $1,129,261, as against 66,123.79 ounces, valued at $1,366,900 in 1906, a decrease of 11,495.79 fine ounces in quantity and $237,639 in value. The largest yield of gold continues to come from Baker County, although that showed some falling off from the year 1906. The next county in rank of gold production was Jackson, followed by Josephine, Grant, Lane, Malheur, and Curry, in order named, all the other counties having each turned out less than $10,000 during the year. The largest production from quartz mines was from Baker County and the largest from placers was from Josephine County. The most productive gold quartz mine is in Baker County and the most productive placer (hydraulic) is in Jackson County. Sixty-three quartz mines produced gold in 1907, compared with 71 in 1906. Productive placer mines numbered 141 in 1907, compared with 205 in 1906—a material falling off in number. In 1907 the placers yielded in gold $331,406, as compared with $361,560 in 1906. The loss was mainly in hydraulic mines, which in 1907 yielded $66,441 less than in 1906. The dredges and the drift and surface placers increased their gold output in 1907 over 1906 by $36,287, this increase coming mainly from dredging operations. There are 96 productive hydraulic mines, 5 drift mines, 2 dredges, and 38 sluicing or placer properties.

The gold production from different kinds of mines, by counties, for 1907, is given in the following table:

Source of gold product in Oregon, by kinds of ore, in 1907, by counties, in fine ounces.

County.	Placers.	Deep mines.			Grand total.
		Siliceous ores.	Copper ores.	Total.	
Baker	2,987.35	27,539.45		27,539.45	30,526.80
Coos and Curry	344.58	318.40		318.40	662.98
Crook		10.26		10.26	10.26
Douglas	215.61				215.61
Grant	741.93	2,893.21	266.06	3,159.27	3,901.20
Harney	16.45				16.45
Jackson	5,180.91	3,501.91		3,501.91	8,682.83
Josephine	5,866.10	1,438.04	468.18	1,906.22	7,772.31
Lane		1,845.89		1,845.89	1,845.89
Malheur	615.52	309.75		309.75	925.27
Union	36.28				36.28
Wallowa		5.08		5.08	5.08
Wheeler	27.04				27.04
Total	16,031.77	37,861.99	734.24	38,596.23	54,628.00
Increase (+) or decrease (−)	−1,458.69	−10,339.97	+302.88	−10,037.09	−11,495.79

The following table shows the source of placer gold in Oregon, by counties, in 1907:

Source of placer gold in Oregon in 1907, by counties.

County.	Hydraulic mines.	Surface placers, drift, and dredging.	Total value.
Baker	$38,348	$23,406	$61,754
Coos and Curry	3,565	3,558	7,123
Douglas	3,726	731	4,457
Grant	12,899	2,438	15,337
Harney		340	340
Jackson	71,007	36,092	107,099
Josephine	96,879	24,384	121,263
Malheur	12,134	590	12,724
Union		750	750
Wheeler	447	112	559
Total	239,005	92,401	331,406
Increase (+) or decrease (—)	— 66,441	+ 36,287	— 30,154

SILVER.

The silver yield of Oregon in 1907 aggregated 86,718 fine ounces, valued at $57,234, as compared with 79,346 ounces, valued at $53,162, in 1906, an increase of 7,372 ounces in quantity and of $4,072 in value. By far the greater part of the silver came from Baker County, the yield of that county for the year having been $45,929 out of the total of $57,234. The quartz mines of the State yielded $54,833 in silver, the copper ores $559, and the placers $1,842. The source of silver, by counties and kinds of ore, in 1907 is shown in the following table:

Source of silver product in Oregon, by kinds of ore, in 1907, by counties, in fine ounces.

County.	Placers.	Deep mines.			Grand total.
		Siliceous ores.	Copper ores.	Total.	
Baker	560	69,029	....	69,029	69,589
Coos and Curry	58	374	....	374	432
Crook	....	26	....	26	26
Douglas	62	....	....	....	62
Grant	164	10,330	273	10,603	10,767
Harney	3	....	....	....	3
Jackson	944	2,324	....	2,324	3,268
Josephine	894	232	574	806	1,700
Lane	....	727	....	727	727
Malheur	94	38	....	38	132
Union	6	....	....	....	6
Wallowa	....	....	....	....	....
Wheeler	6	....	....	....	6
Total	2,791	83,080	847	83,927	86,718
Increase (+) or decrease (−)	−563	+7,542	+393	+7,935	+7,372

COPPER.

The copper output of Oregon is small, amounting altogether to 554,104 pounds in 1907, valued at $110,821, as compared with 415,803 pounds in 1906, valued at $80,250. The increase for 1907 over 1906 was 138,301 pounds in quantity and $30,571 in value. All the copper comes from Grant and Josephine counties, the larger part being from the last-named county. There are very few copper-producing mines in Oregon, but some new ones are being opened and developed in 1908.

PROGRESS OF MINING INDUSTRY IN OREGON IN 1907.

Altogether, as compared with the year 1906, the State of Oregon showed in 1907 a decrease of $202,996 in the total value of the gold, silver, and copper produced. The values of both silver and copper increased to some extent, and the loss in values is entirely due to decreased gold output. Although this was mainly due to the reduced tonnage of siliceous ore, the placer mines were also responsible to some extent, the water season having been a poor one. Quite a number of gold mines formerly producers were idle during 1907. Reports were received from 206 producing mines of all kinds, while 555 properties were reported nonproducing. In 1906 there were 279 producing mines from which reports were received. The quantity of gold derived from siliceous ore was $213,746 less in 1907 than in 1906, and that derived from placers was $30,154 less. The larger number of the placers in the State are hydraulic mines, there being 96 producing ones out of a total of 141, and it was the reduced yield from this class of mines, owing to scarcity of water, that caused the falling off of placer yield for the year.

Fourteen of the counties of Oregon made some metal production in 1907, and over half of the entire yield was derived from Baker County. Next in productive importance was Jackson County, followed in order by Josephine, Grant, Lane, Malheur, and Curry. Baker County increased its tonnage of ore by 10,992 tons in 1907, as compared with 1906, yet the total yield of the county was $54,699 less, showing a material reduction in the average value of the ore mined. Grant, Jackson, and Malheur counties also increased their tonnage, but Josephine County mined 49,206 tons less in 1907 than in 1906, and Coos, Curry, and Douglas counties also showed reduced quantities. Altogether there were 27,576 tons less ore than in 1906, which is the apparent reason for the reduction shown in the total output. The loss is altogether from siliceous ores, the copper ore showing a material gain, as is evidenced by the table in this chapter showing the subdivision of tonnage of ore treated in 1907.

As to placer gold output, Baker County nearly doubled its figures in 1907 over 1906, but nearly all the other counties of the State showed a falling off of gold yield from this source, the decrease being most apparent in Douglas, Grant, Jackson, and Josephine. Malheur and Harney counties increased their placer yield slightly. Grant County did not produce half as much from its placers in 1907 as it did in 1906. There are two dredges operating productively in Oregon—one in Grant and one in Jackson County. In Baker County a new company is drilling on ground on Clarke Creek in the Burnt River field, and expects to operate a dredge before the close of 1908; and another company will install one in Pine Creek, a tributary of Burnt River.

In Baker County, the United Elkhorn mine, a large producer, was not operated during the entire year 1907, and the plant of the Columbia Mining Company was not worked to its full capacity. This mine has been equipped with electric power. The Eureka and Excelsior mines were idle during the year. At the Iron Dyke mine, where much development has been done of late, a 50-ton smelter was built for copper ores. At Sanger an electric power plant is being built to furnish power for several mining properties, and a new mill and concentrator are being built at Sparta. In Curry County some new copper mines are being opened adjacent to Chetko Harbor, but no production has yet been made. There were no quartz mines operated in Douglas County in 1907 as there were in 1906. In Grant County the Red Boy mine milled no ore during 1907, though work in the mine was continued. There is now a 100-ton concentrating mill in the Quartzburg district, Grant County. It is to be noted that several concentrating plants and cyanide plants were installed in Oregon during 1907, these being mentioned in the text of the counties where they are situated. Galice district in Josephine County was at one time quite productive and now bids fair to become so again, there being considerable activity in that locality. The Mount Pitt mine, in Jump-Off-Joe district, in the same county, has installed a large cyanide plant, which is now in service. The Greenback Mining Company, in the same county, built a large and complete reduction plant during the year, and this is operated by electric power. At the Queen of Bronze mine a pyritic matte plant has been completed.

Oregon contains two distinct mining regions differing in character of deposits and ores. Southwestern Oregon practically constitutes the extension of the gold belt of California, and the counties are, in order of present importance, Jackson, Josephine, Lane, Coos and Curry, and Douglas. Their combined gold production in 1907 was

$396,478, which is a very decided reduction of about $200,000 from the output of 1906. The placer gold won from this region was $239,942, a decrease of somewhat less than $40,000. The gold from deep mines was $156,536, a decrease of about $166,000 from 1906. The greatest reduction appeared in Josephine County, and was partly due to the closing of the Greenback mine for practically the whole year. The silver production of southwestern Oregon was only 6,189 fine ounces.

Northeastern Oregon embraces chiefly Baker, Grant, Malheur, and Union counties, although smaller amounts are contributed by Crook, Harney, Wallowa, and Wheeler counties. Their combined gold production in 1907 was $732,783, a loss of about $37,000 as compared with 1906. The value of the placer gold of northeastern Oregon was $91,464, a decided increase of nearly $20,000 as compared with 1906. The lode mines yielded $641,309 in gold, which is approximately $56,000 less than the output of 1906. The silver production of northeastern Oregon was 80,529 fine ounces.

Although some of the mines in Oregon which were unproductive in 1907 were in course of development, by far the greater number of the 555 nonproducing mines reporting were virtually idle, being held only by assessment work. Although reports were received from 761 mines, of which but 206 made any production for the year. This might be taken to indicate that more capital for mining purposes is badly needed in the State, so that these mines might be developed and be brought into the ranks of the producers.

Production of gold, silver, and copper in Oregon in 1907, by counties.

County.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		
Baker	30,526.80	$631,045	69,589	$45,929			$676,974
Coos and Curry	662.98	13,705	432	285			13,990
Crook	10.26	212	26	17			229
Douglas	215.61	4,457	62	41			4,498
Grant	3,901.20	80,645	10,767	7,106	54,440	$10,888	98,639
Harney	16.45	340	3	2			342
Jackson	8,682.83	179,490	3,268	2,157			181,647
Josephine	7,772.31	160,668	1,700	1,122	499,664	99,933	261,723
Lane	1,845.89	38,158	727	480			38,638
Malheur	925.27	19,127	132	87			19,214
Union	36.28	750	6	4			754
Wallowa	5.08	105					105
Wheeler	27.04	559	6	4			563
Total	54,628.00	1,129,261	86,718	57,234	554,104	110,821	1,297,316

The following table shows, by counties, the tonnage of ore, concentrates, and old tailings in 1907:

Tonnage of ore, concentrates, and old tailings in Oregon in 1907, by counties, in short tons.

County.	Total tons of ore sold or treated.	Increase (+) or decrease (−) compared with 1906.	Concentrates produced.		Old tailings treated.
			Quantity.	Value in gold and silver.	Quantity.
Baker	69,881	+10,992	3,299	$246,702	8,976
Coos	4	− 136			
Crook	10				
Curry	35	− 270			
Douglas		− 2,342			
Grant	9,058	+ 6,712	390	7,148	
Jackson	14,923	+ 5,279	562	17,275	
Josephine	5,995	−49,206	15	786	
Lane	8,647		134	3,390	
Malheur	2,142	+ 1,392			
Wallowa	3	+ 3			
Total	110,698	−27,576	4,600	275,301	8,976
Average value per ton of ore	$8.71	+ $0.49			

The total tonnage by kinds of ore sold or treated in each county of Oregon in 1907 is shown in the following table:

Subdivision of tonnage of ore sold or treated in Oregon in 1907, by counties, in short tons.

County.	Siliceous ore.	Copper ore.	Total.
Baker	69,881		69,881
Coos	4		4
Crook	10		10
Curry	35		35
Douglas			
Grant	4,558	4,500	9,058
Harney			
Jackson	14,923		14,923
Josephine	3,435	2,560	5,995
Lane	8,647		8,647
Malheur	2,142		2,142
Union			
Wallowa	3		3
Wheeler			
Total	103,638	7,060	110,698
Increase (+) or decrease (−)	−32,694	+5,118	−27,576
Average value per ton in gold and silver	$8.08	$2.23	$7.71

In 1906 the subdivision of the tonnage was as follows: Siliceous ore, 136,332; copper ore, 1,942; total, 138,274 tons.

The following table gives the number of mines, classified according to their chief product, in the counties of Oregon in 1907:

Number of mines classified by chief product in Oregon in 1907, by counties.

County.	Non-producing mines.	Gold placer mines.					Deep mines.				Total mines reporting product.
		Hydraulic.	Drift.	Dredging.	Sluicing.	Total.	Gold.	Silver.	Copper.	Total.	
Baker	168	16	2	......	7	25	21	......	......	21	46
Coos	14	1	......	......	3	4	1	......	......	1	5
Crook	5	......	......	......	......	......	1	......	......	1	1
Curry	19	4	......	......	2	6	1	......	......	1	7
Douglas	28	6	......	......	3	9	......	......	......	......	9
Grant	80	7	1	1	3	12	9	......	1	10	22
Harney	7	......	......	......	1	1	......	......	......	......	1
Jackson	70	21	......	1	6	28	8	......	......	8	36
Josephine	90	35	2	......	8	45	15	......	1	16	61
Lake	1	......	......	......	......	......	......	......	......	......	......
Lane	49	......	......	......	......	......	2	......	......	2	2
Malheur	5	5	......	......	2	7	4	......	......	4	11
Union	12	......	......	......	1	1	......	......	......	......	1
Wallowa	4	......	......	......	......	......	1	......	......	1	1
Wheeler	3	1	......	......	2	3	......	......	......	......	3
Total	555	96	5	2	38	141	63	......	2	65	206

PRODUCTION BY INDIVIDUAL COUNTIES.

BAKER COUNTY.

Metallic production of Baker County, Oreg., in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		
1906	33,652.22	$695,653	53,708	$35,984	185	$36	$731,673
1907	30,526.80	631,045	69,589	45,929	......	......	676,974
Increase (+) or decrease (−).	−3,125.42	−64,608	+15,881	+9,945	−185	−36	−54,699

Baker is the most productive county in Oregon, but in 1907 its output fell off from that of 1906, as did that of the entire State. The yield of 30,526.80 ounces of gold, valued at $631,045 in 1907, is $64,608 less in value than that of 1906. The silver product was 15,881 ounces, or $9,445 more than in 1906; and this, with no copper product for the year as compared with a nominal quantity in 1906, makes the total decrease in 1907 in Baker County $54,699. There were 46 producing mines in the county in 1907, as compared with 51 in 1906. The placers numbered 25, of which 16 are hydraulic, 7 sluicing, and 2 drift. There were 21 quartz properties, which yielded 69,881 tons of siliceous ore in 1907, which is 10,992 tons more than were produced in 1906. The gold yield of these ores was 27,539.45 fine ounces, valued at $569,291, and the silver yield was 69,029 ounces, valued at $45,559. The average value per ton was $8.15 in gold and 65 cents in silver, a total of $8.80 in both gold and silver. The placer mines of the county yielded $61,754 in gold, as compared with $33,859 in 1906, an increase of $27,895. There were 3 more of this class of mines worked in 1907 than in 1906.

Baker City district.—Included in this will be considered the mines in Baker, Elkhorn, Virtue, and Pocahontas districts, the number of deep mines being small. The principal producers are the United Elkhorn Mining Company, Virtue Mine Development Company, Uncle Dan Mining Company, and the Mattoon Mining Company, the latter at Pocahontas. The United Elkhorn mine, the largest producer, shipped all its ores to the smelter at Sumpter; but it was closed down in September, 1907. The Virtue mine has a shaft 800 feet deep, and there are said to be 6 parallel veins in the property. The 20-stamp mill, and other machinery, is now driven by electric power. The Mattoon Company has a 40-ton Elspass mill, without concentrators, but it was only run a short time in 1907. As to placers, a few sluicing properties were worked, and one drift mine, the Stices Gulch Placer Mining Company. The 2 hydraulic mines operated were the Clarke Creek Mining Company and the Gold Nest mines. The Western Exploration and Dredging Company has been testing with drills the ground in the Burnt River fields at Clarke Creek and expects to have some production by the end of the season of 1908. There were numbers of mines in this district, both deep and placer, which reported " no production " in 1907. All the mines combined in the district yielded $63,936 in 1907.

Cracker Creek district.—The principal deep mines at Bourne in this district are the Columbia Mining Company, the Eastern Oregon Mining Company, and the Orleans Gold Mining Company. The Columbia Company has a 3-compartment shaft 918 feet deep, with levels every 100 feet, and 3 tunnels with a total lentgh of 2,048 feet. The mine is very completely developed, there being 17,134 feet in drifts. The reduction plant consists of a 20-stamp mill, with plate-amalgamation and concentration, cyanide plant, auxiliary rolls, crushers, and trommels. The plant was only operated on partial capacity in 1907, owing to extreme scarcity and high price of labor and to the change from steam to electric power. The property is now completely equipped with electric power at mill, cyanide plant, shaft-house, pumps, and hoist. The Eastern Oregon Mining Company, the largest producer in the district, has its mine (The North Pole) developed by 5 tunnels. It has a 30-stamp mill with plate amalgamation and concentration. The sands are cyanided by percolation and the slimes by agitation. The Orleans Gold Mining Company, operating the Green Chariot mine, went out of business during the year and the mine is now worked by others. The total yield of the mines at Bourne in 1907 was $336,991. The Eureka and Excelsior mine, formerly a large producer, has been idle for two years.

Cornucopia district.—In this district there are 3 producing quartz mines and 1 placer. The Cornucopia Mines of Oregon is the most important property and is equipped with a 20-stamp plate-amalgamation mill and Frue vanners. The Stampede Mining Company has a 10-stamp mill and a cyanide plant of a daily capacity of 50 tons. The mine is now being developed with a crosscut tunnel 900 feet in length, but the ore thus far mined was obtained from a 400-foot crosscut tunnel, tapping the vein at the 150-foot level. The ore in 1907 was obtained from the Mayflower claim of the company. The Queen of the West Mines Company has a 20-stamp mill. The only placer producing in the district is the Boulder Creek drift mine. The total output of the district in 1907 was $128,031, making it the second in importance in the county.

Other districts.—At Cable Cove there is only 1 quartz producer, the Imperial Mining and Development Company, which has a 50-ton concentration plant. There are 5,000 feet of tunnels on the property. There are numbers of idle mines in the district. At Connor Creek the only productive property is the Connor Creek Mining and Milling Company, which has a 20-stamp mill with concentrators. In 1907 the mine was being retimbered and the ore bodies opened up. The tunnel, 4,300 feet long, gives a vertical depth of 1,350 feet on the vein. At Durkee the mines are all small hydraulic properties. At Geiser, Bonanza district, there are a few operating quartz and placer mines. No ore was milled from the Bonanza mine. In Greenhorn district the mines are small producers. At Hereford the Burnt River Consolidated Gold Mining and Dredging Company is working a hydraulic mine, but expects to install a dredge in 1908. The mine is on Pine Creek, a tributary of Burnt River. At Homestead there is 1 small quartz producer. Nothing in the way of ore output will occur in this district until a railroad, under construction by the Oregon Short Line Company, is completed in the fall of 1908. Little output except for testing purposes has been made from the camp. The principal ores are copper, and of such a grade that they will not admit of the long wagon haul now necessary to get them to market. The Iron Dyke has the greatest development of all the properties in the camp, several hundred thousand dollars having been expended upon it. There are 4,000 feet of tunnels, drifts, and upraises, and a 50-ton smelter has been built. Newbridge and Richland districts both have small outputs only. Rye Valley district has 2 producing hydraulic mines. At Sanger the Sanger Gold Mines Company are developing a new portion of their property, the Summit vein having been found west of the fault. The Eagle River Electric Power Company is erecting a power plant on Eagle Creek to furnish power to the Sanger mine, as well as to the Virtue mines, 8 miles east of Baker City. At Sparta the Eagle Creek Ditch and Milling Company is working bench gravel with a hydraulic elevator. The Oregon Big Four Mining Company is building a new mill and concentrating plant and the property is being developed. No ore has yet been treated. The North American Copper Company is developing its property by shaft and crosscut. The Oregon Mining and Irrigating Company produced nothing in 1907, but much time was spent in building ditches, flumes, etc., preparatory to active work in 1908.

At Sumpter only a small production was made from placer mines. The Highland Gold Mines Company was in litigation in 1907 and produced nothing, though it has 3,500 feet of tunnels and an Elspass mill with concentrators. The Golconda Consolidated Mining Company, which has a 20-stamp mill, was closed down in 1907 for lack of capital to operate. At both Vincent Creek and Weatherby there was only a very small production. Mormon Basin district mines are mostly in Malheur County, but there is 1 important property which lies just over the border in Baker County. This is the Commercial Mining Company (Rainbow mine), which has a mill of 19 stamps, consisting of 1 battery of 5 stamps and 14 individual stamps. The mine is a large producer.

COOS AND CURRY COUNTIES.

The mines in these two counties are both quartz and placer. The principal district in Coos County is Johnson Creek, just over the line from Curry County. The Salmon Mountain Coarse Gold Mining Company has prospects of becoming a good copper mine, but the production in 1907 was gold. There are several small placer mines producing in this district. In Curry County, in Harbor district, there is 1 quartz mine producing, the Higgins. It has a small 3-stamp mill which crushes 25 tons of the soft ore in twenty-four hours. Most of the ore treated is packed on horses nearly a mile over the mountain so that only the high-grade ore is milled at present. Beach sand mines are operated in this county at Denmark, Illahe, Marial, and Ophir. Some of these mines are on old beaches, 5 miles from the present ocean beaches. At the majority of these placers the sand is simply shoveled into sluices. Considerable platinum is found but very little is saved. One company is equipping to work on a large scale for platinum. The Chetko Copper Company is developing mineral adjacent to Chetko Harbor, where it owns about 720 acres of land. The copper veins are to be mined by tunneling and the ore can be conveyed to a seaport near by.

In Crook County very little mining is done, and returns were received from only 1 producer.

DOUGLAS COUNTY.

Only placers were in operation in this county in 1907, though in 1906 3 quartz mines produced 2,342 tons of siliceous ore, and the larger proportion of the gold output came from them. These quartz mines were not operated in 1907. For this reason mainly the output of gold and silver in the county was $40,669 less in 1907 than in 1906. None of the placer mines are large, and all are in the districts of Myrtle Creek, Cow Creek, including its tributary, Starveout Creek, Olalla, Perdue, and Riddle. Some of these placers are described by J. S. Diller in "Contributions to Economic Geology, 1907."[a]

GRANT AND HARNEY COUNTIES.

The value of the output of Grant County in 1907 was $80,645 in gold, $7,106 in silver, and $10,888 in copper (54,440 pounds), a total of $98,639, and an increase in 1907 of $32,778. The increase was mainly in gold, though some is shown in copper values also. In Austin district there was only a nominal output. At Canyon City the mines are all operated by hydraulic process, the principal producers being the Caledonian Mining Company, the Quartz Gulch Mining Company, and the Fitch. In Granite district the Buffalo-Monitor Mining Company has no mill and ships its ores to smelters at Sumpter and Tacoma. The Independence Mining Company at the same place now has a cyanide plant. The Ben Harrison mine, which has now been taken over by the Oregon-Idaho Investment Company, shipped some ore in December, 1907, but it was not treated at the smelter until 1908. The Red Boy Consolidated Mining and Milling Company was in active development in 1907 with 40 men at work, but the 20-stamp mill was not operated.

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[a] Bull. U. S. Geol. Survey, No. 340, 1908.

In this district the Western Mining and Development Company operated a dredge for one month in the season of 1907. Most of the placer mines in the district are operated by hydraulic process, but the water season was very short and the yield for the season was much less than usual. This water shortage caused a decrease in the placer yield in this county of $12,893 in 1907. In Beech Creek district the only producer was the Black Butte Mining Company. In the Quartzburg district the Equity Copper and Gold Mining Company has a small mill and concentrator. The tunnels on the property aggregate 4,000 feet in length. The mine was only worked by lessees in 1907, the company having been crippled by litigation. The ore carried some copper, and was sold to the Oregon Smelting and Refining Company. The Present Need mine was also worked by lessees. The Standard Consolidated Mines Company has a 100-ton concentrating mill (rolls), and the ores yield gold, silver, and copper. The concentrates were treated at the smelter at Sumpter. About 6 tons of cobalt concentrates were recovered in treating this ore. At Susanville a good deal of ore from old dumps was worked in the 10-stamp custom mill.

In Harney County there was only 1 small placer mine operated during 1907.

JACKSON COUNTY.

There was very little difference between the yield of this county in 1906 and in 1907, the increase having been only $963 for the year 1907. The value of the entire yield in 1907 was $179,490 in gold, and $2,157 in silver, or $181,647 in all. In Applegate district is the Stirling Mining Company, which is the largest hydraulic mine in Oregon in point of annual yield. The other mines in the district are hydraulic or sluice. The Star is a small quartz mine, and the values have lately been tested with a 5-stamp mill having concentrators. At Ashland no producers reported, but the Ashland Mining and Milling Company has been organized by Los Angeles men to work the old Ashland mine, 3 miles west of that city. The Ashland Peak Mining Company, has installed power drillls and is developing the property. The Star Gold Mining Company, owning 21 lode claims on Wagner Creek, has renewed development work on its properties. Near Gold Hill and Rock Point are the districts of Foots Creek, Galls Creek, and Sardine Creek. On Foots Creek the mines are all worked by the hydraulic process, with the exception of one which was worked by a dredge, operated by the Champlin Dredging Company, for about half the year 1907. On Galls Creek there are 2 quartz mines, the Braden and the Bill Nye Mining Company. The latter has a 5-stamp mill. The Braden has a 10-stamp mill with concentrators. There are a number of hydraulic mines, the principal of which are the Blockert, the Galls Creek Mining and Development Company, and the Sperry mine. At Sardine Creek is the Corporal G. quartz mine, the Lucky Bart quartz mine, and the Ketchum & White hydraulic mine. The Corporal G. has its ore treated at a local custom mill, and the Lucky Bart has a 5-stamp mill with concentrators. These two quartz mines are described in detail in Bulletin No. 340 of the United States Geological Survey.

In Jacksonville district are the properties of the Opp Mining Company, consisting of 373 acres of mineral land. There are 7 tunnels cutting 3 main veins, the longest one of which is 876 feet. There is a 20-stamp mill with concentrators, and in 1908 a cyanide plant was installed. This mine is the largest producer in the county. The Harms Mining Company owns the Forest Creek mine, 5 miles from Jacksonville, and the Blossom, 8 miles from Gold Hill. A mill will be built by the company during 1908. On Evans Creek the mines are all placers, most of them being worked by the hydraulic process. They lie along the creek between Woodville and Weimer. Phoenix is the post-office of placers on Andersons Creek, where a few mines are being worked.

JOSEPHINE AND LANE COUNTIES.

The value of the output in Josephine County in 1907 was $261,723, which makes it second in productiveness of Baker County. Of the total production there were 7,772.32 ounces of gold, valued at $160,668; 1,700 ounces of silver, valued at $1,122; and copper to the value of $99,933. No comparison can be made of the relative outputs of 1906 and 1907 in this county, because in the report for 1906 its figures were combined with those of Lane County. Althouse and Sucker Creek districts made their entire yield from small placers. Applegate Creek and its tributaries have all placers except one, that being the Mountain Lion Mining Company, at Davidson post-office, which has a 5-stamp mill with concentrator. In Galice district there is a good deal of development going on and considerable capital is coming in. The Almeda Consolidated mines built a smelter in 1908. The largest hydraulic mine in the district is the Old Channel Mining Company; and among other producers are the Oriole (quartz), and the Golden Bar and the Rocky Gulch (hydraulic) mines. The Granite Hill district has only 1 productive mine, the American Goldfields Company, which has a 20-stamp mill with plate-amalgamation and concentration. The vertical shaft on this mine is 400 feet deep. Jump-Off-Joe district has several placer mines and 2 deep producing mines, the Baby, belonging to the Capital City Mining Company, and the Mount Pitt Hydraulic and Quartz Mining Company. Both these mines are described in detail in Bulletin No. 340 of the United States Geological Survey. The Baby has a 5-stamp mill with concentrators, and has over 1,500 feet of tunneling. The Mount Pitt also has a 5-stamp mill, with concentrators, and a 50-ton cyanide plant was installed at the end of the year 1907.

The mines of Kerby district are all placers, the principal ones being the Wilson and Anderson (hydraulic), the Martin Bros., and the Flintlock. Grave Creek has both placer and quartz mines. The Greenback Mining Company has 40 stamps, with crushers, 12 concentrators, and cyanide plant. The plant is equipped with an electric-power system, the power being brought from Tolo, a distance of 30 miles. Work on the mine was stopped in August, 1906, and there was only a slight production made at the end of 1907 from a clean up at the mill. Below the Greenback on the same creek is the Hammersley mine, which has a 5-stamp mill, with concentrators and cyanide plant. The Mormon and St. Peters mines made some yield from pockets in 1907. The veins in this district are narrow. The Columbia Mines Company operate on Grave Creek one of the large hydraulic properties of the State. Other hydraulic mines are the Brown and the Red Hill. In the vicinity of Leland, on Grave Creek, there are 4 hydraulic mines being worked, these being the Brimstone Creek, the Crackerjack, the Steam Beer, and the Widow. Some of the mines here mentioned are described in detail in Bulletin No. 340 of the United States Geological Survey. In Silver Creek district there is 1 hydraulic mine producing. This is owned by the Northwest Mines Company. The Hellgate Mining Company, below Merlin, made a small production. In Pickett Creek district the Flanagan & Emerson hydraulic mine was the sole producer. In Waldo district, at Takilma, is the property of the Takilma Smelting Company, working the Queen of Bronze mine. The company has a 150-ton pyritic-matte plant for treatment of its own ore, but no custom ore is handled. The Waldo Smelting and Mining Company at the same place did not operate in 1907. In this district are several productive hydraulic mines, the most important of which are the Logan, the Allen Gulch, the Deep Gravel Mining Company, and the Fry Gulch. A considerable quantity of platinum was saved in 1907 in these mines. Wolf Creek district has 2 productive deep mines and some placers. The Sylvanite near Golden is a deep mine, as is the Martha, owned by the Greenback Mining Company and worked by lessees in 1907, who treated the ore in their own mill.

Lane County has 2 productive quartz mines, but there are no active placers in the county.

MALHEUR COUNTY.

In Malheur County there are 4 quartz mines, each making a small output. Most of the production comes from placer mines. In 1907 the county yielded a product valued at $19,214, which is $4,926 more than the value of 1906. There is only one district, the Mormon Basin. The mines there are mostly hydraulic, and their total gold yield in 1907 was $12,724. The most prominent producer is the mine of the Colt Bros.

UNION, WALLOWA, AND WHEELER COUNTIES.

Union County has a few small placers near La Grande. Wallowa County has a small lode mine at Joseph. Wheeler County mines are at Antone and are all placers. None of these counties yielded as much as $1,000 for the year 1907.

SOUTH DAKOTA.

By Chester Naramore.

PRODUCTION.

Returns received from the mines of South Dakota show that during the calendar year 1907 there were produced 200,184.89 fine ounces of gold, valued at $4,138,189, and 93,895 fine ounces of silver, valued at $61,971. This is a decrease of $2,703,280 in gold, of 56,980 fine ounces of silver, and of 22,719 pounds of lead, as the mines reported no base metals for 1907.

Twenty-four deep mines (five less than in 1906) furnished a production in 1907 of 1,471,156 short tons of siliceous ore, with an average value per ton in gold and silver of $2.85, as compared with 1,780,674 tons, averaging $3.90 per ton, in 1906.

Production of gold, silver, and associated metals in South Dakota in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold........fine ounces..	330,956.06	$6,841,469	200,184.89	$4,138,189	−130,771.17	−$2,703,280
Silver ....do....	150,875	101,086	93,895	61,971	− 56,980	− 39,115
Lead ....pounds..	22,719	1,295	(a)	(a)	− 22,719	− 1,295
Total..............	....	6,943,850	....	4,200,160	....	− 2,743,690

[a] None reported.

There was undoubtedly some lead and a little copper obtained from the ores and concentrates shipped to smelters at Denver and Omaha, but the quantity was too small for the mining companies to receive pay for it. There was no smelter operating in the Black Hills in 1907.

The year 1907 was indeed an unfortunate one for the mining industry in the Black Hills, and especially so during the first six months. The decrease of 309,518 tons was due to the fire at the Homestake mine and to strikes at the other large producers. The year opened with a strike threatening, and early in January a walkout occurred, causing seven of the larger companies of the Black Hills to remain idle for the first half of the year. The Homestake Company, whose output normally represents over three-fourths of the production of the State, granted the demands for an 8-hour day, and was able to keep up its output until interrupted by the big fire, which started late in March.

Again, the financial troubles at the close of 1907 interrupted work on properties which were merely in the developing stage. In spite of these misfortunes an unusual number of mills were completed and put into commission during the year. The smelter at Rapid City ceased operations upon the completion of the remodeling of the Mogul mill, as this company furnished the bulk of the ore reduced at the smelter during its run in 1906.

Source of gold and silver production in South Dakota in 1907, by kinds of ore, in fine ounces, with tons of ore treated from deep mines.

County.	Gold.			Silver.			Total tonnage siliceous ore sold or treated in 1907.
	Placer.	Deep mines: Siliceous ore.	Total.	Placer.	Deep mines: Siliceous ore.	Total.	
Custer and Pennington	14.80	155.57	170.37	0	65	65	1,002
Lawrence	29.90	199,984.62	200,014.52	6	93,824	93,830	1,470,154
Total	44.70	200,140.19	200,184.89	6	93,889	93,895	1,471,156
Total, 1906	302.34	330,653.72	330,956.06	73	150,802	150,875	1,780,674
Decrease	257.64	130,513.53	130,771.17	67	56,913	56,980	309,518

CUSTER COUNTY.

The gold production of Custer County in 1907 was less than half the output for 1906, and has been tabulated with Pennington County in order not to expose the productions of individual mines.

Development work during 1907 placed some ore on the dump at the Catawassa mine, 8 miles northwest of Custer. Operations on the Mayflower, Tonda, and Copper Queen groups were confined to assessment work. The Ivanhoe Gold Mining and Milling Company is equipped with a Chilian mill, plates, and a 50-ton cyanide plant. The Ideal Mining Company, at Custer, has a 350-foot tunnel, and plans to erect a stamp mill with cyanide tanks during 1908. At the Empire-Baker group, at Custer, the year 1907 was spent in extending the development work, which now includes two 100-foot double-compartment incline shafts and several surface cuts. The Saginaw Gold Mining and Milling Company, of Custer, has a 380-foot vertical shaft and 340 feet of tunnel work. The company is installing a 10-stamp mill, with plates, tables, and cyanide tanks.

Nine miles west of Custer, in the Danby section, the Wabash Gold Mining and Milling Company spent the year in developing its properties and patenting claims.

Custer was the center of a greatly increased mica production during 1907.

LAWRENCE COUNTY.

The production of Lawrence County (the source of over 99.9 per cent of the total tonnage of South Dakota) amounted to less than two-thirds of the totals of 1906, and shows a falling off in 1907 of 301,223 short tons, of $2,681,529 in gold, and of 56,707 fine ounces of silver.

Production of gold and silver in Lawrence County in 1906 and 1907, in fine ounces.

Year.	Gold.		Silver.		Total.
	Quantity.	Value.	Quantity.	Value.	
1906	329,733.49	$6,816,196	150,537	$100,860	$6,917,056
1907	200,014.52	4,134,667	93,830	61,928	4,196,595

Nineteen deep mines produced 1,470,154 short tons of siliceous ore in 1907, with an average gold and silver value per ton of $2.85, as against 23 deep mines in 1906, with an output of 1,771,377 short tons and an average value per ton of $3.90.

The fire at the Homestake mine caused over one-half of the decrease in quantity of ore handled in the county, as well as lowering the grade of ore, since much low-grade surface ore was handled by mills of the company while the mine was being unwatered. The balance of the decrease in tonnage is directly due to the idleness caused by the strikes at the mines and mills during the first five months of 1907.

The 3 active placer mines produced in 1907 only about one-tenth as much as was reported from 4 placer mines in 1906.

Indications point to a greatly increased output from this country during 1908, and the production from the Homestake mine alone will exceed the entire State output for 1907, if no unforeseen hindrances occur.

The year 1907 witnessed an increased use of electric power at the different mines and mills of Lawrence County. The Consolidated Light and Power Company completed its large plant, and at Spearfish the Black Hills Traction Company began furnishing power to the mining companies in that section from its new hydro-electric plant, which has a capacity of 1,200 horsepower.

At the great Homestake mine indications in the first part of the year pointed to a much larger output for 1907, because of the increasing savings made by the slimes plant as more presses were put in service, until the fire started on March 25. After fighting the fire with hose lines and then by forcing steam into the burning section it was finally found necessary to flood the workings. There was a complete shut-down of all the mills for a period of 37 days, while the water from every available source was turned into the mine. On May 29 pumping was started to unwater the mine, and a number of the stamps were started on surface ores. During July the water was lowered to below the 700-foot level, and all of the 1,000 stamps were placed in commission. The 1,550-foot level was unwatered by October 15. The latter months of 1907 and the first of 1908 witnessed the completion of the slimes plant, so that at present the great mine is turning out more bullion than ever before.

The following companies were hindered by strikes: The Golden Reward, Mogul, Imperial, Reliance, Lundberg, Dorr and Wilson, Clinton, Portland, and Wasp Number 2.

The Golden Reward Company holds 444 mining claims. The main workings include 6 vertical shafts and about 25 miles of laterals and drifts. The properties were idle from January 1 to June 6, 1907.

The Imperial Company operated its properties on Bald Mountain from July to December. The Mogul Mining Company, controlling the Ben Hur, Horseshoe, Mogul, North Lode, and Farm groups of mines, near Terry, finished the remodeling of its mill at Pluma into a 350-ton wet crushing cyanide plant. The Buxton and Bonanza properties were worked by the Lundberg, Dorr and Wilson Company through a 1,500-foot tunnel. This company also operates a 100-ton wet crushing cyanide mill (crushing in solution), in which it handles custom ores in addition to the product of its own mines.

The Portland Gold Mining Company, at Greenmont, in the Bald Mountain section, shipped ore to the mill mentioned and to smelters during the latter half of the year.

The Reliance Gold Mining Company, in the same section, resumed operations after the strike. The mine is developed by a 122-foot vertical shaft and 7,000 feet of tunneling, and is equipped with a 150-ton cyanide mill, in which the ore is passed through crushers, rolls, and four 6-foot Huntington mills.

The Wasp Number 2 Mining Company mines its ore from an open cut and mills it in a 200-ton dry crushing cyanide plant, and is able to handle very low grade rock.

The Golden Crest Mining Company remained inoperative until the first week in October before accepting the 8-hour schedule. A 20-ton dry crushing cyanide mill was operated at the Dividend mine, at Greenmount, and the Esmeralda Mining Company reduced its ore for about three months in a 40-ton Huntington mill.

In the Two Bit district the Monarch Gold Mining Company made some shipments to smelters. The developments include a 212-foot shaft and 1,200-foot tunnel. The Horseshoe-Comet, in the Bear Butte section, also shipped ore out to smelters.

The following notes pertain to mines reporting development work for 1907. The American Eagle Mining and Milling Company, at Portland, in the Bald Mountain district, was building a cyanide mill with a capacity rated between 250 and 300 tons, which was expected to be completed during the spring of 1908. During 1907, the Bryant Mining and Milling Company, at Spearfish, ran 450 feet of tunnel in a quartz contact in the Potsdam formation, and the Elliptic Mining Company ran about 1,000 feet of crosscut tunnel from the bottom of its shaft, which is 603 feet deep. The Pluma Mining Company, at Lead, has a 700-foot tunnel and 3 shafts, respectively 530, 225, and 186 feet deep, and the surface equipment includes 2 plate-amalgamating stamp mills, one with 40 and the other with 20 stamps.

The development work of the Squaw Creek Mining Company, in the Carbonate district, included 2 shafts about 60 feet deep, with drifts and tunnels.

Development work was also carried on by the Amaqueene Gold Mining Company, at Pactola, in the Box Elder district; by the Gold Queen Mining Company and the Hercules Mining Company, in the Galena district. The North Homestake Mining Company, controlling the Maitland properties, remained closed during 1907 because of labor troubles.

PENNINGTON COUNTY.

The precious metal production from Pennington County in 1907 amounted to about one-eighth of that in 1906, and was derived mostly from deep mines, as the placer output was almost negligible. The smelter at Rapid City remained closed throughout the year.

The Canton Mining Company, at Hill City, has a 180-foot incline shaft and a 300-foot drift and is equipped with a 24-ton Chilian mill, 16-foot plates, and a Card concentrator. The milling operations were hindered by lack of water.

The Golden West Gold Mining Company, in the Hornblende district, southwest of Rochford, operates a Chilian mill on ore extracted from an open cut, and further development has been begun by sinking a shaft. Ore similar to that of the Homestake mine is reported.

The Cordelia Mining Company, in the Rochford section, operates its property through a 250-foot shaft and 700 feet of tunnel and reduces the ore in a 10-stamp plate-amalgamating mill.

The Balkan Mining and Milling Company, in the same vicinity, was erecting a 5-stamp, plate-amalgamating mill during 1907. The Clara Belle Mining Company has been in the hands of a receiver since the 1st of July, 1907.

The properties of the Continental Copper Mining and Smelting Company, at Hill City, are developed by a 550-foot vertical shaft, and a 380-foot tunnel. Work on another tunnel was begun. The 150-ton matting furnace was not operated in 1907.

The Gertie Mining and Milling Company, at Hill City, was in litigation and idle throughout the year. The Stanby Mining Company has been opening up its holdings for the last 8 years, and the developments now include a 250-foot vertical shaft, a 3,000-foot tunnel, and numerous surface cuts. The owners were overhauling their 60-stamp mill in 1907 and adding a cyanide plant to treat the tailings.

Development work was reported by the Bullion Gold Mining and Milling Company; the North Fork Gold Mining and Milling Company and the Heyland group, in the Keystone section; the Gopher Gold Mining Company, at Hill City; the Harvest Mining Company, in the Rapid Creek section; and by the Annie mine, at Rochford.

TEXAS.

By H. D. McCaskey.

PRODUCTION.

Production of gold, silver, and associated metals in Texas in 1906 and 1907.

Year.	Gold.		Silver.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		
1906	77.012	$1,592	301,772	$202,187	49,030	$2,795	....	....	$206,574
1907	.435	9	303,688	200,434	23,947	1,269	44,000	$2,596	204,308
Increase (+) or decrease (−)	−76.577	−1,583	+1,916	−1,753	−25,083	−1,526	+44,000	+2,596	−2,266

For the year 1907 Texas producers are to be credited with an output of 0.44 fine ounces of gold, valued at $9, and 303,688 fine ounces of silver, valued at $200,434, a total production of precious metals valued at $200,443. Compared with the corresponding figures for 1906 this production shows a decrease of 76.58 fine ounces of gold, valued at $1,583, and an increase of 1,916 fine ounces of silver, but a decrease in value of $1,753, owing to the lower price of silver in 1907. This shows a total decrease in the value of the production of the precious metals of $3,336 as compared with the production of 1907. During the year Texas also produced 23,947 pounds of lead, valued at $1,269, and 44,000 pounds of zinc, valued at $2,596. There was thus a decrease of 25,083 pounds in quantity and of $1,526 in value of lead, and an increase of zinc production amounting to the entire output, as no production of this metal was reported from the Texas mines for 1906. The total value of the production of the precious and base metals mentioned above for Texas for 1907 was therefore $204,308. This is $2,266 less than the corresponding production for 1907.

The precious metals and the lead, as in 1906, were all obtained from the dry ores, of which 19,615 short tons were treated. The average values of extractions per ton of ore were a negligible amount of gold and $10.22 in silver.

During 1907 considerable prospecting for lead and zinc was reported from El Paso County and several properties produced small quantities of shipping ores of zinc during development work. The Calumet and Texas Mining Company also reported extensive development work on copper deposits in the Guadalupe Mountains but no production as yet owing to inadequate facilities for transportation. A railroad through this portion of the county is said to be projected. In Presidio County production was confined to the precious metals and lead, the Shafter mine being the principal producer. The silver and lead ores at present mined are chiefly oxidized products of the argentiferous galena occurring in the Cibolo limestones of Carboniferous age.

UTAH.

By V. C. Heikes.

PRODUCTION.

The value of the output of gold, silver, copper, lead, and zinc by 165 deep mines and 14 placer operators in 1907 was $31,692,911. This is an increase of $273,546 over the output in 1906. The increase in value of the total output is due to copper, which more than made up for the falling off in the production of the other metals. The total ore mined amounted to 2,669,696 short tons, with an average value of $11.87 per ton, as against 2,348,819 short tons, with an average value of $13.37 per ton in 1906, an increase in 1907 of 320,877 tons in quantity and a decrease of $1.50 in average value per ton. The average gold and silver value per ton in 1906 was $5.51; in 1907 it was $4.63 per ton, a decrease of 88 cents per ton. The total value of the gold and silver output for 1907 was $12,375,096, which was $582,215 less than the 1906 production, or a decrease of $96,740 in gold and of $485,475 in silver. In 1907, at 8 gold and silver mills, 2 of which used the cyanide process, 3 amalgamation and cyanide, and 3 amalgamation, there were treated 263,020 tons of ore, valued at $885,779, containing $858,027 in gold and 42,049 ounces of silver, averaging per ton, gold, $3.26; silver, 0.16 ounces. Concentration of ores was carried on in 23 mills, situated in 7 counties, as follows: Salt Lake, 10; Summit and Wasatch, 7, which includes 4 tailing plants on Silver Creek in Summit County; Juab, 2; and Iron County, 1. At these concentration mills there were treated 1,211,197 tons of ore, which produced 139,049 tons of concentrates (8.71 tons into 1). The ratio of concentration of the copper-bearing porphyry at Bingham is 20 tons of ore into 1 of concentrate, which makes the state ratio of concentration high. From the concentrates were recovered $296,285 in gold and 1,729,901 ounces of silver, an average of $2.13 in gold and 12.44 ounces in silver per ton. Crude ore shipped to smelters amounted to 1,188,767 tons, yielding $3,958,273 in gold, and averaging $3.33 per ton; 9,218,029 ounces of silver, an average of 7.75 ounces per ton; of old slag, 1,892 tons were resmelted and 6,712 tons of tailings were reconcentrated. The contents of slag are included under crude ore and those of tailings under concentrates. The statement of production for 1906 and 1907 showing increases and decreases, and valued at each year's commercial prices, is as follows:

Production of gold, silver, and associated metals in Utah in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold......fine ounces..	252,439.43	$5,218,386	247,759.63	$5,121,646	− 4,679.80	− $96,740
Silver ....do....	11,550,634	7,738,925	10,990,076	7,253,450	− 560,558	− 485,475
Copper ....pounds..	56,593,576	10,922,560	64,256,884	12,851,377	+ 7,663,308	+1,928,817
Lead ....do....	125,342,836	7,144,542	115,938,037	6,144,716	− 9,404,799	− 999,826
Zinc.............do....	6,474,615	394,952	5,452,916	321,722	− 1,021,699	− 73,230
Total..........	....	31,419,365	....	31,692,911	....	+ 273,546

Total tons of ore sold or treated in Utah in 1902–1907, in short tons, total and average value of ore in gold and silver per ton.

Year.	Quantity.	Gold and silver value.	Average gold and silver value.
1902	1,114,785	$9,784,481	$8.78
1903	1,412,379	10,862,231	7.69
1904	1,716,947	11,087,600	6.46
1905	2,181,061	11,806,148	5.41
1906	2,348,819	12,948,660	5.51
1907	2,669,696	12,365,971	4.63

According to the general classification of ores as used in this volume, an ore containing less than 2½ per cent of copper or 4½ per cent of lead is classed as a dry or siliceous ore. This method is also used in classifying iron pyrite ore and oxidized iron ore. For the years previous to 1907 the yield of several kinds of ore that were separately shipped by the same producers was not given separately to the Geological Survey.

ORE PRODUCTION, 1907.

The largest tonnage of ore mined in Utah is that of the copper ores, which represented 67.16 per cent of the State total, and from which 63.84 per cent of the gold and 31.37 per cent of the silver were extracted. The lead ores aggregated 21.57 per cent of the total tonnage, yielding 18.64 per cent of the gold and 66.42 per cent of the silver. Siliceous ores equaling 10.51 per cent of the total tonnage yielded 17.3 per cent of the gold and 1.20 per cent of the silver. Copper-lead ore carried the highest average values per ton in gold and silver, or $13.48; lead ore contained values of gold and silver of $10.02; siliceous ore, of $3.36; copper ore, of $3.09; lead-zinc ore, of $2.89, and zinc ore, of $1.78. Under the siliceous-ore heading is included some iron ore mined and shipped as fluxing material.

Subdivision of tonnage, by kinds, of ore sold or treated from Utah in 1907, by counties, in short tons.

County.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver, Emery, Iron, Piute, and Sevier[a]	56,960	216,590	13,377	(b)	....	....	291,179
Boxelder, Millard,[a] Morgan, and Washington	4,467	20,342	104	....	11	....	24,924
Grand, Garfield, San Juan, and Uinta	205	6	....	....	....	....	211
Juab	17,313	155,040	69,652	....	423	....	242,428
Salt Lake	....	1,399,759	120,850	....	2,369	....	1,522,978
Summit and Wasatch	....	1,295	229,333	....	....	5,000	235,628
Tooele	201,616	52	101,017	(b)	117	....	310,801
Utah	....	....	41,547	....	....	....	41,547
Total	280,561	1,793,084	575,880	12,251	2,920	5,000	2,669,696
Value per ton in gold and silver.	$3.36	$3.09	$10.02	$1.78	$13.48	$2.89	$11.87

[a] No production 1907.

[b] Separation would disclose individual production.

GOLD.

The total gold production for Utah amounted to 247,759.63 ounces, valued at $5,121,646, in 1907, as against 252,439.43 ounces, valued at $5,218,386, in 1906, a decrease of 4,679.80 ounces in quantity and of $96,740 in value. The greater part of the year's supply came from Juab, Salt Lake, Tooele, Piute, Utah, and Summit counties, which are arranged in the order of their importance. The increase in output by deep mines was in Boxelder, Juab, and Utah counties, and from placers, in the southern counties, through which the Colorado, the Grand, and the San Juan rivers flow. The yield from placers in 1906 was 416.63 ounces, and in 1907 was 438.35 ounces, an increase of 21.72 ounces. New appliances on San Juan River and the reported installation of a dredge on Green River, in Uinta County, should soon bring a larger yield. Ore rich in gold, containing copper and lead, was shipped by the car lot from the Mammoth and Centennial-Eureka mines in Tintic district, Juab County. Due to these rich ores, found at a depth of 2,000 feet and over, the district records an increased yield. The Tintic district, covering part of Juab and Utah counties, carries the distinction of having the largest yield of gold in 1907, aggregating nearly 46 per cent of the total quantity; the next district is West Mountain (Bingham), in Salt Lake County, with

30.62 per cent, followed by Camp Floyd district, in Tooele County, with 10.87 per cent. Copper ores, aggregating 1,793,084 tons, contained 158,154.83 ounces of gold, or 63.84 per cent of the total production in Utah, and included 674,345 tons of monzonite porphyry, mined at Bingham, and containing 5,576.83 ounces of gold, yielding an average of 0.008 ounces, or 17 cents per ton. Lead ore contained 46,170.73 ounces of gold; copper-lead ore, 123.77 ounces, and lead-zinc ore, 18.06 ounces. No gold was reported from zinc ore. Siliceous ores, aggregating 280,561 tons, and yielding 42,853.89 ounces of gold, included 255,298 tons of ore treated by the cyanide process, which saved 39,687.89 ounces of the gold, averaging 0.153 ounces, or $3.16 per ton. At gold and silver mills 263,020 tons of ore were treated, yielding 41,507.06 ounces of gold, valued at $858,027, an average of $3.26 per ton. Concentration mills made 139,049 tons of concentrates, which yielded 14,332.76 ounces of gold from the concentration of 1,211,197 tons of ore. The average gold content of the concentrates was 0.103 ounces, or $2.13 per ton. Crude ore to smelters amounted to 1,188,767 tons, containing gold 191,481.44 ounces, valued at $3,958,273, an average of 0.161 ounces, or $3.33 per ton.

Source of gold production of Utah, by kinds of ore, in 1907, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver, Emery, Iron, Piute, and Sevier[a]	....	12,936.57	2,311.86	425.55	....	....	....	15,673.98
Boxelder, Millard,[a] Morgan, and Washington	....	2,220.24	8.52	.22	....	.14	....	2,229.12
Grand, Garfield, San Juan, and Uinta	438.35	120.77	....	....	....	....	....	559.12
Juab	....	661.69	87,088.84	20,237.15	....	25.24	....	108,012.92
Salt Lake	....	....	68,690.70	7,927.54	....	88.93	....	76,707.17
Summit and Wasatch	....	....	54.91	8,340.55	....	....	18.06	8,413.52
Tooele	....	26,914.62	....	687.94	....	9.46	....	27,612.02
Utah	....	....	....	8,551.78	....	....	....	8,551.78
Total	438.35	42,853.89	158,154.83	46,170.73	....	123.77	18.06	247,759.63

[a] No production 1907.

SILVER.

The silver yield amounted to 10,990,076 ounces, valued at $7,253,450, in 1907, as against 11,550,634 ounces, valued at $7,738,925, in 1906, a decrease of 560,558 ounces in quantity and of $485,475 in value. Tintic and Park City districts in Juab, Utah, Summit, and Wasatch counties produced 7,743,634 ounces of the silver, which represents 70.4 per cent of the State total. The silver credited to the 2 districts is largely derived from the lead ores of replacement deposits in limestone associated with intrusive rocks. The yield from this source is 335,061 tons of ore and 5,601,691 ounces of silver, or an average per ton of 16.71 ounces. The remainder of the output in silver credited to the 2 districts, or 2,141,943 ounces, is derived from copper, copper-lead, lead-zinc, and siliceous ores, but 95 per cent of the quantity, or 2,034,295 ounces, came from 155,040 tons of copper ore produced in the Tintic district, and averaged 13.12 ounces of silver per ton. The copper ore produced in the Tintic district is 5.8 per cent of the total tonnage of copper ore produced in Utah, and contained 18.51 per cent of the total quantity of silver. The next greatest quantity of silver produced from copper ores is 1,316,323 ounces, credited to Salt Lake County, from mines yielding 1,399,759 tons, 99.9 per cent of which, mined in West Mountain (Bingham) district, contained 1,234,835 ounces of silver, or an average of 1.13 ounces per ton. Included in the tonnage of copper ores is the monzonite porphyry, mined at Bingham, aggregating 674,345 tons, which yielded, after concentration, 51,723 ounces of silver, averaging in the crude ore 0.077 ounces, worth about 5 cents per ton in 1907. Dry or siliceous ores, aggregating 280,561 tons, included 17,313 tons of iron ores and 180 tons of siliceous silver ore. Of the dry or siliceous ores mined 93.7 per cent was treated at gold and silver mills. Zinc ore, as reported by 2 producers, averaged 7.77 ounces per ton. Copper-lead ore, aggregating 2,920 tons, contained 55,804 ounces of silver, averaging 19.11 ounces per ton. The greater part, or 1,805 tons of the copper-lead ore, averaging 17.19 ounces, was produced in the Little Cottonwood district of Salt Lake County, and 564 tons, containing an average of 12.80 ounces, were from the Bingham mines in the same county. Lead-zinc ore represented 5,000 tons of old tailings reconcentrated near Park City and containing an average of 4.26 ounces per ton. From 1,211,197 tons of ore sent to concentration mills 139,049 tons of concentrates were produced, containing 1,729,901 ounces of silver, and averaging 12.44 ounces per ton. From 1,188,767 tons of crude ore shipped to smelters 9,218,029 ounces were produced, an average of 7.75 ounces per ton; and from bullion produced by gold and silver mills 42,049 ounces of silver were produced from 263,020 tons of ore, an average of 0.16 ounces per ton.

Source of silver production of Utah, by kinds of ore, in 1907, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver, Emery, Iron, Piute, and Sevier[a]	....	40,014	91,929	230,630	33,059	....	....	395,632
Boxelder, Millard,[a] Morgan, and Washington	....	4,621	4,376	345	....	464	....	9,806
Grand, Garfield, San Juan, and Uinta	97	1	144	....	....	....	....	242
Juab	....	71,190	2,034,295	1,503,693	....	14,015	....	3,623,193
Salt Lake	....	....	1,316,323	831,413	....	38,261	....	2,185,997
Summit and Wasatch	....	....	1,105	2,772,109	....	....	21,338	2,794,552
Tooele	....	15,770	....	449,638	....	3,064	....	468,472
Utah	....	....	....	1,512,182	....	....	....	1,512,182
Total	97	131,596	3,448,172	7,300,010	33,059	55,804	21,338	10,990,076

[a] No production 1907.

COPPER.

The copper output increased from 56,593,576 pounds, valued at $10,922,560, in 1906, to 64,265,884 pounds, valued at $12,851,377, in 1907. The greatest production and increase came, as usual, from West Mountain district at Bingham, credited in 1907 with 70 per cent of the State total, or 45,431,964 pounds, valued at $9,086,393, an increase of 6,077,688 pounds in quantity and of $1,477,508 in value over the production of 1906. Eight companies at Bingham, ranging in copper output from 1,500,000 pounds to 15,000,000 pounds, mined 78 per cent of the total tonnage of copper ore, which contained 70 per cent of the total copper produced in Utah. Two companies in 1907 used steam shovels for handling the overburden and mining the monzonite porphyry, which contains a low percentage of copper. Steam shovels of the 90-ton size, equipped with the 5-yard dipper, handle 350 tons of ore per hour. There are 9 steam shovels at work, 4 on the Boston Consolidated and 5 on the Utah Copper claims, both groups of claims being located on the porphyry belt.

Contrary to a strict interpretation of the classification of ores generally followed throughout this report, the monzonite porphyry ores mined at Bingham and Newhouse, Utah, also certain pyritic iron ores mined at Bingham, all being chiefly treated for the copper content though averaging less than 2.5 per cent of that metal, are classed with the higher grade material under copper ores. These copper ores mined in Utah aggregated 1,793,084 tons, of which Bingham is credited with 57.58 per cent, or 1,032,546 tons, yielding 27,669,645 pounds of copper, an average of 26.79 pounds per ton, equivalent to 1.34 per cent. Fifty-three per cent, or 953,543 tons, of Utah's copper ores are siliceous in character and contain from 5 per cent to 2 per cent copper, averaging 1.29 per cent. The yield of copper from the siliceous copper ores aggregated 19,219,158 pounds, which is 29.9 per cent of the State total. The Bingham monzonite porphyry, included under siliceous copper ore, aggregated 674,345 tons and yielded 15,827,574 pounds of copper, averaging 23.47 pounds per ton, equivalent to 1.17 per cent. The yield of copper from Bingham monzonite porphyry is 24.6 per cent of Utah's total copper output.

Up to the close of 1907 there were 3 concentration mills, the Winnamuck mill, leased by the Ohio Copper Company, and 2 plants, 1 at Copperton and 1 at Garfield,[a] operated by the Utah Copper Company, treated monzonite porphyry ore. One of these plants, situated below Bingham, at Copperton, and erected by the Utah Copper Company, is an experimental mill, finished April, 1904, and operated continuously since then. It has been enlarged from time to time to the present capacity of about 800 tons per day.

Mining companies in Utah report shipments to smelters of crude copper and lead ores aggregating 1,188,767 tons and yielding 44,245,168 pounds of copper. The total quantity of concentrates shipped to smelters aggregated 139,049 tons, of which 79.19 per cent, or 110,123 tons, contained 20,011,716 pounds of copper, averaging 181.72 pounds, equivalent to 9.86 per cent per ton. The concentrates were produced in Beaver, Salt Lake, Summit, Tooele, and Wasatch counties, and represented 1,098,331 tons of crude ore mined and milled, including 6,712 tons of old tailings, which were reconcentrated.

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[a] The milling plant of the Boston Consolidated Mining Company, situated near the mill of the Utah Copper Company at Garfield, began the treatment of monzonite porphyry ore in January, 1908, and at the time of writing these notes the company report a saving of 70 per cent of the values.

LEAD.

The lead produced in Utah decreased from 125,342,836 pounds, valued at $7,144,542, in 1906, to 115,938,037 pounds, valued at $6,144,716, in 1907, a loss of 9,404,799 pounds in quantity and of $999,826 in value. The most notable increase was in Utah County, for which is recorded 21,823,587 pounds, valued at $1,156,650, an increase of 11,051,684 pounds in quantity and of $542,651 in value. Utah County is credited with the production of the American Fork district and of the mines in the eastern part of Tintic district. The Tintic district, which covers a portion of the two counties, Juab and Utah, produced 33,019,242 pounds of lead, valued at $1,750,019, an increase of 997,052 pounds in quantity, but a decrease of $75,246 in value. The largest yield of lead in 1907 came from the Park City region, which produced 36,234,757 pounds, valued at $1,920,442, a decrease from the production of 46,511,176 pounds, valued at $2,651,137 in 1906, equal to 10,276,419 pounds in quantity and $730,695 in value. The largest producers of lead in Utah are the Silver King, the Daly West, and the Daly Judge mines in the Park City region. In Tintic district the Colorado mine leads, with Beck Tunnel and Bullion Beck following. In American Fork district, Utah County, the old Miller Hill property leads; in Beaver County, the Horn Silver mine; in Salt Lake County, the Dalton and Lark mine, and in Tooele County the Honerine. Crude ore containing lead was mined and shipped to smelters from 11 counties and amounted to 1,188,767 tons, containing 82,356,156 pounds of lead. Sixty-three per cent of the concentrates produced in Utah, or 87,687 tons in quantity, contained 33,581,881 pounds of lead, averaging 382.97 pounds per ton, and equivalent to 19.15 per cent. The lead concentrates were produced in 7 counties and represented 254,303 tons of crude ore mined and milled, including 6,712 tons of old tailings, which were reconcentrated.

ZINC.

Summit, Tooele, and Beaver counties continue to be the only counties with mines producing zinc. The output in 1907 amounted to 5,452,916 pounds in quantity and to $321,722 in value, which, compared with 6,474,615 pounds, valued at $394,952, in 1906, is a decrease of 1,021,699 pounds in quantity and $73,230 in value. The decrease was due to the fact that the operators of the Daly Judge mine in Summit and Wasatch counties reserved its product for treatment by a dry concentration process installed at Park City by the Grasselli Company, of Cleveland, Ohio. The milling plant is equipped with 5 Sutton dry tables, 1 di-electric separator, 1 crusher, 2 gas engines, and dry sizing apparatus. The plant will be in operation in 1908.

MINING INDUSTRY OF UTAH IN 1907.

The year 1907, with the exception of the last two months, was a very active one, taxing the capacity of both ore producers and of smelting works. The high prices paid for metals brought out much ore of low grade, which it was impossible to market in former years.

The number of dividend-paying mines, which numbered 20 in 1906, amounted to 24 in 1907, distributed by counties as follows: Beaver, 2; Boxelder, 1; Juab, 15; Salt Lake, 3; Summit and Wasatch, 3. The dividends of record amounted to $5,373,992, which does not include the amounts paid by the United States Smelting and Refining Company and the American Smelting and Refining Company, which derive no small part of their earnings from their respective enterprises in the State. On account of the decrease in metal prices and the general financial stringency, the copper mines in Utah began curtailing the output in September. As a result of this, there was a very marked falling off in the demand for labor at the mines and smelters. The first serious retrenchment began at Bingham when the Boston Consolidated Mining Company laid off 300 men. Then the United States Mining Company shut down its Telegraph mine and practically stopped work at the Galena mine. The Bingham Consolidated Mining Company ceased production at its Commercial mine, and the Tintic Mining and Development Company closed down the Yampa mine and smelter. Following the closing of the mines, the Bingham Consolidated, United States, and Utah Consolidated smelters commenced preparations for closing their plants. The smelters operating after the 1st of January, 1908, were the Murray lead plant of the American Smelting and Refining Company and the copper plant of the Garfield Smelting Company at Garfield. The capacity of the latter plant was brought to 1,200 tons of ore daily before the close of the year. The equipment of this includes McDougall roasters and a Huntington and Heberlein converter plant with 20 pots. Large bins have been constructed for the storage of 25,000 tons of crude ore and concentrates. From these bins the ore is conveyed by Robins belt to the sampling mill and from there to the blast-furnace bin and the McDougall roasters. The plant is built for a daily capacity of 1,500 tons. The Utah Smelting Company operated its copper furnaces, situated north of Ogden, up to the time market conditions in the metals caused a suspension of operations. The Bingham Consolidated Company's smelter at West Jordan was closed indefinitely.

Railroad building continued during 1907, and the Western Pacific Railway was completed to Bews in Nevada. It benefits the Deep Creek region to a considerable extent, but to reach the mines in the Clifton district a spur track of 40 miles will have to be built. The completion of the Rio Grande Western Company's "sky line" at Bingham has been an important event, making more extensive operations possible in the mining of the copper-bearing monzonite porphyry. In Juab County, in Tintic district, the Eureka Hill Railway Company is building a line of narrow-gage railroad to connect various mines with the smelter of the Tintic Smelting Company under construction near Silver City.

On account of the scarcity of fuel, electric power is rapidly taking the place of steam in several Utah mining camps. The Telluride Power Company has installed a number of generating stations, as follows: Two on the Provo River in Utah, 1 on Battle Creek in Utah County, 1 on the Jordan River in Salt Lake County, and 1 on the Logan River in Cache County. Consolidated with these stations is the Grace Station on Bear River in Bannock County, Idaho. The power of these stations will aggregate 43,300 horsepower. The standard transmission voltage is 40,000, and in most instances delivery is made at this voltage to customers. The output of the stations mentioned is used for lighting a number of towns and cities in Utah, and is used for mining, milling, smelting, and other industries in the Tintic, West Mountain, and Camp Floyd districts, also at Garfield and other points. The transmission consists of approximately 600 miles of 40,000-volt lines and about 75 miles of 5,000-volt lines. It is stated that aluminum wire equal to No. 4 copper wire is used for more than three-fourths of the line connecting the 6 stations. The power is measured by Bristol or other standard curve-drawing wattmeters, and rates range from $5.40 per horsepower per month for a 500-horsepower plant to $8 per horsepower per month for the smaller plants using 4 to 14 horsepower.

The plant of the Beaver River Power Company, near Beaver City, in Beaver County, was finished the latter part of 1907 and will furnish power and light to Milford, Frisco, and Newhouse at rates ranging from $6.40 per horsepower per month for 500 horsepower plant to $10 per horsepower per month for the smaller plants using 5 to 24 horsepower.

In American Fork Canyon, near the town of the same name, are located 2 electric power plants of the Utah County Light and Power Company. A third one is to be constructed during 1908. These plants supply the small towns and large pumping plant at the mouth of Jordan River for Salt Lake City. It also delivers power to the Tintic mining district.

Near Park City, in Summit County, the Ontario Mining Company operates a power plant at the mouth of its drain adit. This plant supplies electric power to its own property and to the Daly West mine.

Mining timber used in the mines is shipped from Oregon. Only a small percentage of the native timber is consumed.

In the following table is shown the output of gold, silver, copper, lead, and zinc for the year 1907, by counties:

Production of gold, silver, copper, lead, and zinc in Utah in 1907, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Beaver, Emery, Iron, Piute, and Sevier[a]	15,673.98	$324,010	395,632	$261,118	5,653,122	$1,130,625
Boxelder, Morgan, Millard,[a] and Washington	2,229.12	46,080	9,806	6,471	2,609,401	521,880
Garfield, Grand, San Juan, and Uinta	559.12	11,558	242	160	1,987	397
Juab	108,012.91	2,232,825	3,623,193	2,391,307	7,755,831	1,551,166
Salt Lake	76,707.17	1,585,678	2,185,997	1,442,758	46,506,202	9,301,241
Summit and Wasatch	8,413.52	173,923	2,794,552	1,844,404	945,722	189,144
Tooele	27,612.02	570,791	468,472	309,192	739,521	147,904
Utah	8,551.78	176,781	1,512,182	998,040	45,098	9,020
Total	247,759.63	5,121,646	10,990,076	7,253,450	64,256,884	12,851,377

[a] No production reported from Sevier and Millard counties in 1907.

Production of gold, silver, copper, lead, and zinc in Utah in 1907, by counties—Continued.

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Beaver, Emery, Iron, Piute, and Sevier	4,491,292	$238,039	1,039,144	$61,310	$2,015,102
Boxelder, Morgan, Millard, and Washington	71,300	3,779			578,210
Garfield, Grand, San Juan, and Uinta					12,115
Juab	15,489,512	820,944			6,996,242
Salt Lake	24,308,988	1,288,376			13,618,053
Summit and Wasatch	36,234,757	1,920,442	258,784	15,268	4,143,181
Tooele	13,518,601	716,486	4,154,988	245,144	1,989,517
Utah	21,823,587	1,156,650			2,340,491
Total	115,938,037	6,144,716	5,452,916	321,722	31,692,911

Tonnage of ore sold or treated, number of producing mines, and tenor of ores in Utah in 1906 and 1907, by counties.

County.	Ore sold or treated (short tons).		Number of deep mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	1907.	Increase (+) or decrease (−).	1906.	1907.	1906.	1907.	1906.	1907.
Beaver, Emery, Iron, Piute, and Sevier[a]	291,179	− 27,594	19	28	$6.38	$6.92	$2.00	$2.01
Boxelder, Millard,[a] Morgan, and Washington	24,924	+ 18,369	5	10	23.60	23.20	6.89	2.11
Garfield, Grand, San Juan, and Uinta	211	+ 195	1	3	18.06	14.17	18.06	12.29
Juab	242,428	− 59,293	30	41	25.01	28.86	15.75	19.07
Salt Lake	1,522,978	+506,056	35	40	12.22	8.94	3.12	1.99
Summit and Wasatch	235,628	− 29,164	15	16	22.12	17.58	10.43	8.57
Tooele	310,801	−109,284	13	17	5.61	6.40	2.76	2.83
Utah	41,547	+ 21,592	8	10	51.68	56.33	20.91	28.28
Total	2,669,696	+320,877	126	165	13.37	11.87	5.51	4.63

[a] Millard and Sevier counties were producers in 1906 only.

Tonnage of ore to gold and silver mills and concentrating mills, with amount of gold and silver contained in bullion produced in Utah, in 1907, by counties.

County.	Ore to gold and silver mills.			Ore to concentrating mills.
	Quantity.	Gold in bullion.	Silver in bullion.	
	Short tons.		*Fine oz.*	*Short tons.*
Beaver, Emery, Iron, Piute, and Sevier	56,912	$264,588	38,366	189,261
Boxelder, Millard, Morgan, and Washington	4,467	35,027	3,645	
Garfield, Grand, San Juan, and Uinta	205	2,497	1	
Juab				9,706
Salt Lake				748,027
Summit and Wasatch				178,290
Tooele	201,436	555,915	37	83,393
Utah				2,520
Total	263,020	858,027	42,049	1,211,197
Per ton		3.26	0.16	

Production of gold, silver, and associated metals from Utah concentrates in 1907, by counties.

County.	Quantity.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.	*Fine oz.*	*Fine oz.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beaver, Emery, Iron, Piute, and Sevier	21,436	1,431.96	36,809	2,690,520	....	....	$592,000
Boxelder, Millard, Morgan, and Washington	127	525.81	976	....	18,739	....	12,506
Garfield, Grand, San Juan, and Uinta	....	....	....	....	....	....	....
Juab	2,089	87.22	23,605	....	1,347,913	....	88,821
Salt Lake	53,331	8,593.51	335,334	16,302,555	7,305,217	....	4,046,652
Summit and Wasatch	34,679	3,218.76	1,031,926	318,873	16,836,038	258,784	1,718,961
Tooele	26,883	423.69	288,894	699,768	7,723,492	....	748,728
Utah	504	51.81	12,357	....	350,482	....	27,803
Total	139,019	14,332.76	1,729,901	20,011,716	33,581,881	258,784	7,235,471

Production of gold, silver, copper, lead, and zinc from Utah crude ore shipped to smelters in 1907, by counties.

County.	Crude ore.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.	*Fine oz.*	*Fine oz.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beaver, Emery, Iron, Piute, and Sevier	45,006	1,442.54	320,427	2,962,602	4,491,292	([a])	$1,133,192
Boxelder, Millard, Morgan, and Washington	20,457	8.86	5,185	2,609,401	52,561	....	528,272
Garfield, Grand, San Juan, and Uinta	6	....	144	1,987	....	....	492
Juab	232,722	107,925.69	3,599,588	7,755,831	14,141,599	....	6,907,421
Salt Lake	774,951	68,113.66	1,850,663	30,203,647	17,003,771	....	9,571,401
Summit and Wasatch	50,626	5,194.76	1,762,626	626,849	19,398,719	....	2,424,220
Tooele	25,972	295.94	179,541	39,753	5,795,109	([a])	684,850
Utah	39,027	8,499.99	1,499,825	45,098	21,473,105	....	2,312,688
Total	1,188,767	191,481.44	9,218,029	44,245,168	82,356,156	5,194,132	23,562,536

[a] County figures can not be given on account of disclosing individual production.

Number of mines classified by chief products in Utah in 1907, by counties.

County.	Mines reporting product.	Gold placer mines, hydraulic.	Deep mines.							
			Gold.	Silver.	Gold and silver.	Gold, silver, and copper.	Gold, silver, copper, and lead.	Gold, silver, and lead.	Silver and lead.	Silver, lead, and zinc.
Beaver, Emery, Iron, Piute, and Sevier	28	....	......	......	5	12	[a] 6	3	2	......
Boxelder, Millard, Morgan, and Washington	10	....	......	1	......	4	2	1	2	......
Garfield, Grand, San Juan, and Uinta	17	14	......	......	2	1	......	......	......	......
Juab	41	....	......	......	1	10	20	8	2	......
Salt Lake	40	....	......	......	......	11	21	6	2	......
Summit and Wasatch	16	....	......	......	......	2	[a] 10	4	......	......
Tooele	17	....	1	......	1	......	8	5	1	1
Utah	10	....	......	......	......	......	1	8	1	......
Total	179	14	1	1	9	40	68	35	10	1

[a] Two reported zinc also.

REVIEW BY INDIVIDUAL COUNTIES.

BEAVER COUNTY.

The total value of the Beaver County output of gold, silver, copper, lead, and zinc in 1907 was $1,713,251, an increase of $45,439 over the output in 1906. This increase, caused by the production of copper from the Cactus mine of the Newhouse Mines and Smelter Corporation, made up for the decrease in lead ore from the Horn Silver mine and the gold of certain other producers. Zinc ore, siliceous in character, of shipping grade, was produced by the Talisman mine in Star district. Sulphide zinc ore was mined and shipped from the Horn Silver mine in San Francisco district and the Moscow mine in the Star district. No value was realized, however, from zinc ore from the latter property. A lead and copper smelter, the property of the Majestic Copper Company at Milford, has been idle for two years, but before the fall in the price of metals a plan to put it into commission was being considered.

Beaver Lake district.—The Majestic Copper Company, operating the O. K. mine in this district, the Harrington Hickory mine in the Star district, and the Old Hickory in the Rocky district, could not hold out with lower prices of metals and ceased work in September. Before the panic there was hope of stripping enough ore from the workings of its Old Hickory claim to give it a new start. The decline in the metal prices, however, cut off the small margin of profit at which it was operating.

Granite district.—In prospecting the King of the Hills claims some ore containing copper and silver was shipped. The ore deposit occurs in a contact between limestone and granite.

Indian Peak district.—The Utah-Indian Peak Mining Company, operating the Silver King property, shipped lead ore containing silver taken out in development work.

Lincoln district.—The Buckeye group of claims produced a test shipment of ore carrying 7 per cent of copper, as well as gold and silver. The Hecla Mining and Milling Company, owning 1 patented claim and 3 locations, actively developed its property and shipped an oxidized lead ore containing gold and silver. The Lincoln mine and the Creole group of claims were under lease to the States Mining Company during the year. The Creole shipped from a contact deposit a number of carloads of oxidized iron ore, with copper and silver. On the Lincoln property a large pump was installed for unwatering the mine, which is opened up to a depth of 400 feet by an incline shaft. No ore shipments were made from this property in 1907, but evidence of its former productiveness is shown by the large dumps of discarded zinc ore, which was sorted from the rich lead ore shipped.

San Francisco district.—According to the published report of the Horn Silver Mining Company for 1907, the zinc ore bodies are estimated at 35,000 tons; lead ore, 40,000 to 50,000 tons, and the mill tailings, 133,000 tons. The gross value of the tailings containing lead and zinc is estimated at $1,285,000. The shipments of ore in 1907 amounted to 14,532 tons, of which 12,327 tons were lead ore, averaging about 21 per cent lead; 159 tons were copper ore, averaging in copper about 18 per cent; and 2,046 tons were zinc ore, averaging about 32 per cent in zinc. The net value received for the total output amounted to $110,181.52. The average cost of ore extraction was $3.63 per ton. This cost included labor on ore, $1.38; labor on dead work, 56 cents; labor on surface, 97 cents; supplies, timber, fuel, etc., 72 cents. The metal contained in the ore shipped amounted to 3,583,554 pounds of lead, 24,508 pounds of copper, 1,244,182 pounds of zinc, 206,537 ounces of silver, and 284.19 ounces of gold. The mining was performed on the 600, 700, and 800 north levels by lessees and the company. Dividends aggregating $5,642,000 have been paid, including $60,000 during 1907.

At Frisco the old slag dumps of the smelters, which treated the Horn Silver ores in the early days of its operation, produced a number of carloads of sorted slag, containing lead and silver. The Imperial mine, now the property of the Nevada-Utah Mines and Smelter Corporation, made important shipments of copper ore, with gold and silver, which was taken out by lessees working on the property. The company owns the Comet claim with a shaft 250 feet deep adjoining the Cactus property. The Washington group, an old patented property in Lober Gulch, now owned by the Cupric Mines Company, made a small test shipment of lead ore. The Newhouse Mines and Smelter Corporation, operating the Cactus mine, made regular shipments of copper concentrate and sulphide copper ore, containing gold and silver, until October, when the output was curtailed one-half. Attention for the rest of the year was given to development in the mine. A winze is being sunk from the adit, or 600-foot level. It is 200 feet deep and will be continued 200 feet deeper, making a total of 1,000 feet from the surface. During the scarcity of fuel coal cost the company $10.75 per ton. Electric power is arranged for with the Beaver River Power Company, which will supply it by the fall of 1908. The concentrator, using Harz jigs and Wilfley tables, has a daily capacity of 600 tons of ore. According to a published report, the tonnage of ore blocked out in the mine is estimated at 4,332,023 tons, with an average content in copper of 2½ per cent. The mill saving is 80 per cent and the production cost of copper is given at 7 cents per pound. The December output of 1,555,472 pounds of copper contained 183.4 ounces of gold and 6,120 ounces of silver. Dividends paid during 1907, amounting to $300,000, were the first paid by the company. The Iron Queen Consolidated Mining Company has taken over the holdings of the former Indian Queen and Leland companies, comprising 30 claims at Newhouse and adjoining the possessions of the Blackbird Company.

Star district.—The Moscow Mining and Milling Company, owning one of the oldest claims in the district, has been a producer during different periods for the last twenty-five years. Development work during this time was carried on in a haphazard way. In 1906 the company was reorganized, and since then the property has been a regular shipper of lead and zinc ores. The main shaft is sunk to a depth of 435 feet. The ore bodies occur at, or in close proximity to, an intersection of a north-south fissure with a certain bed of white granular or somewhat siliceous limestone. It strikes east and west and has a dip of about 35° north. The ore body has a thickness of over 20 feet in places and extends from 15 to 20 feet on either side of a fissure into the limestone. A number of cars of high-grade lead ore was shipped from the property during the year. A deposit of low-grade zinc sulphide, formed on the foot wall, has lead ore above it that is easily kept separate in mining. The Estella mine, operated by the Milwaukee Leasing Company, is opened by a vertical shaft 300 feet deep and an incline shaft 200 feet deep. The mill, equipped for amalgamation, of 25 tons daily capacity, was not operated during 1907. The Progressive Mining Company, operating the Kathleen property, developed with a vertical shaft sunk 165 feet, made several small shipments of ore containing copper and silver. The Cedar Mining Company carried on development work during the year and made shipments of carbonate lead ore, with silver. Its shaft is 275 feet deep. The Talisman Mining Company operated on the Talisman and Stalwart claims, from which was taken at 200 foot depth a high-grade silver-lead carbonate ore, which was shipped to Salt Lake, and a siliceous zinc ore, shipped to Kansas. The St. Mary's group, operated by lessees, made shipments of ore taken from near the surface. The values are mainly of copper, with some silver.

BOXELDER COUNTY.

Lucin district.—The Rosebud claim was productive of a copper-lead ore containing silver. The Salt Lake Copper Company, operating the Copper Mountain mine, is developed by numerous drifts, winzes, raises, etc., aggregating 12,000 feet of work. Regular shipments of oxidized copper ore, with traces of gold and silver, were made to Salt Lake City in 1907.

Park Valley district.—The Century Gold Mining and Milling Company operated its 16-stamp mill, equipped for amalgamation and concentration, during part of the year. The product consisted of gold and silver bullion and a lead concentrate.

Promontory district.—The Lakeside Copper Company developed its property by a vertical shaft 120 feet deep and by 40 feet of drifts. A siliceous copper ore, containing a small quantity of silver, was shipped as a test.

EMERY COUNTY.

Unorganized district.—The Frandsen property, located 14 miles west of Greenriver post-office, on the San Rafael River, made a test shipment of copper ore.

GRAND COUNTY.

La Sal district.—The Boston and Utah Copper Company, near Castleton, has its property developed by 7 prospect drifts, ranging from 20 feet to 255 feet in length, aggregating 1,035 feet. A test shipment of ore, containing copper and silver, was made. The Eureka and Point Lookout group was productive of some gold and silver ore, which was treated in an arrastre.

Miners Basin district.—The Tornado Gold Mining Company was operated during 1907 entirely by lessees, who mined some gold ore which was treated in a 5-stamp amalgamation mill.

IRON COUNTY.

The Jennie Gold Mining Company, at Gold Springs, at the Nevada State line, which started with a milling equipment of 4 Nissen stamps, added 8 in 1907, bringing the total to 12, each crushing an average of 10 tons of gold and silver ore per day. Allowing for stops, repairs, etc., the 12 stamps crush about 100 tons during 24 hours. Below each stamp and 30 feet of amalgamation-plate surface, Pierce amalgamators, 1 to each 3 stamps, are installed. It is stated the treatment costs will not exceed $3 a ton on the crude ore. The company reports that careful sampling and measurement of the ore bodies exposed give an average per ton of $9 in gold and silver. The tonnage is estimated at 70,000 tons blocked out in the mine, which is developed to a depth of 175 feet. The Independence Gold Mining Company has purchased property between its own domain and that of the Jennie and will hasten development. The Big Fourteen property at Stateline shipped ore, produced in 1906, containing gold and silver.

JUAB COUNTY.

Fish Springs district.—The producers of the region are as follows: Utah Mining Company, Fish Springs Mining Company, Galena Mining Company, and Carnation Mining Company. The Utah mine is the largest producer of the district. It is located on the south slope on an east and west spur of the Fish Springs Mountain. In July, 1891, the first shipment of carbonate ore, amounting to 3 tons, assaying 43 per cent of lead and 194 ounces of silver, netted the company $623.10. From that time all expenditures have been met through the productiveness of the property. The owners organized the year following the discovery and capitalized it for 100,000 shares, with a par value of $10, and placed 10,000 shares in the treasury. In January, 1907, the deepest shaft, which is 800 feet, was burned of its lining of timber from top to bottom, and the shaft house was destroyed. Repairs have since been made and an equipment installed consisting of a 150-horsepower gasoline engine and compressor plant for power drills. During the time of repair work, development and production were carried on from an old shaft. Up to the present time all of the shipments have been made from the south or foot wall side of a porphyry dyke about 30 feet wide, which has a slight dip to the north, and this has been followed down to the 800-foot or water level of the mine. The ore occurs in a siliceous dark blue limestone. Some ore also occurs on the other side of this porphyry dyke. This dyke is said to pass through the full length of two adjoining claims, the Galena and the Meteor. The Utah Company paid in dividends during 1907 $24,300, making a total to date of $252,800. The Carnation Mining Company, nearby, is doing development and the Meteor is preparing for active work.

Mount Nebo district.—The Fredie claim, owned by the Nephi Mining Company, is developed by a drift 350 feet long. Lead ore, containing a small amount of silver, was shipped to a Salt Lake smelter.

Tintic district.—The Tintic Smelting Company, which was organized in 1906, selected a site in January, 1907, near Silver City, for their new lead smelter, which is conveniently reached from all mines of the Tintic district. At the close of 1907 this was nearing completion and it began operations in September, 1908. The capacity is 500 tons per day. In May, grading was commenced for the Eureka Hill Railway, which, with the smelting company, is one of the Knight organizations, and is to handle the ore from all of the properties under control, as well as do a custom business. The railroad will be 10 miles long. Beginning with July, freight rates on ores shipped to the Salt Lake Valley smelters from Tintic were reduced, which resulted in increasing the tonnage of low-grade ore. Freight rates in effect are—on ore netting $5 per ton, $1.10; over $5 and under $10 per ton, $1.25; over $10 and under $15 per ton, $1.75; over $15 and under $20 per ton, $2.25; and on ore netting over $50 per ton, $3.

Production of gold, silver, and associated metals in the Tintic district, Juab and Utah counties, Utah, in 1906 and 1907, with increases and decreases.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.............fine ounces..	93,125.07	$1,925,066	113,065.44	$2,337,270	+19,940.37	+$412,204
Silver ....do....	4,610,794	3,089,232	4,949,082	3,266,393	+ 338,288	+ 177,161
Copper ....pounds..	7,321,471	1,413,044	7,755,831	1,551,166	+ 434,360	+ 138,122
Lead ....do....	32,022,190	1,825,265	33,019,242	1,750,019	+ 997,052	— 75,246
Total....................	....	8,252,607	....	8,904,848	....	+ 652,241

In 1907 Tintic district again showed a substantial gain in mineral output, which aggregated a total value of $8,904,848—greater by $652,241 than that of 1906. The increase, both in quantity and in value, was for gold, silver, and copper. The lead production decreased slightly in value. The tonnage of ore mined decreased 39,072 tons, but the average value per ton advanced from $25.98 to $31.97. Large gains were reported in gold by the Centennial-Eureka and the Mammoth mines and in silver by the Colorado mine. In 1906 the producers reporting numbered 31, and in 1907 the number had increased to 40. The district, and in fact Juab County in which it is located, ranks first in the production of gold, silver, and lead, and second in that of copper. The tonnage of ore mined, amounting to 278,504 tons, was shipped to the smelters, with the exception of about 4 per cent which was treated in the 2 concentration mills, and resulted in a lead concentrate valued at $116,624, containing gold and silver. The total tonnage of the district is divided according to metallic content into 17,313 tons of dry or siliceous ore; 155,040 tons of copper ore; 105,728 tons of lead ore, and 423 tons of copper-lead ore. No zinc ore was reported. The copper ores, which constituted 55.66 per cent of the total tonnage of the district, was the source of 77.02 per cent of the gold produced and 41.10 per cent of the silver output. This ore and the lead ore were mined from replacement deposits in limestone. Of pyritic ore, included with dry or siliceous ores, 2,152 tons were mined from deposits in igneous rocks and contained a very small quantity of gold and silver. The ores containing copper are produced mainly in the southern part of the district and average less than 2.5 per cent of copper. This also applies to the lead ores as to the quantity of copper associated, but these ores are sometimes rich in gold. The Mammoth mine in particular produces a siliceous ore which averages over 1 ounce in gold and 5 ounces in silver, but its lead ores are the richest, containing on an average over 3 ounces of gold, 9 ounces of silver, and 15 per cent of lead per ton. The bulk of the lead ores, aggregating 105,728 tons, is a carbonate, and comprises 37.96 per cent of the district total. The lead ores were the source of 22.38 per cent of the gold and 57.17 per cent of the silver. These ores average from $2 to $6 in gold, from 12 to 100 ounces in silver, and 12 to 35 per cent of lead. The ore deposits in Tintic district[a] are of 3 kinds, those in sedimentary rocks, those in igneous rocks, and contact deposits. The deposits in sedimentary rocks are the most important and occur in 4 fracture zones striking north-south. The western fracture, known as the Eureka zone, has the Gemini, Bullion-Beck, Eureka Hill, and Centennial-Eureka mines. The second zone is the Mammoth, having the Eagle, Grand Central, Mammoth, and Sioux-Ajax mines. On the third, or Godiva zone, are the Godiva, May Day, Uncle Sam, Humbug, Northern Spy, Boss Tweed, and North Star claims. The fourth zone, or the eastern fracture, has the Beck Tunnel, Colorado, and Sioux Consolidated mines. In the igneous rock formations the Sunbeam mine is in the monzonite and the Swansea mines in the rhyolite. No contact deposits containing the valuable metals have been found, although considerable prospecting has been performed. The iron ore found on the contact contains a trace of gold and a small quantity of silver. This iron ore, containing 59 per cent of iron, is sold to the lead smelters for flux. On the contact are the Dragoon and Brooklyn mines, both shippers of iron ore. The producers of the district, named in order of the value of their production, are as follows: Centennial-Eureka Mining Company, Mammoth Mining Company, Beck Tunnel Consolidated Mining and Milling Company, Grand Central Mining Company, May Day Mining Company, Bullion Beck and Champion Mining Company, Gemini Mining Company, Yankee Consolidated Mining Company, Eureka Hill Mining Company, Lower Mammoth Mining Company, Uncle Sam Mining Company, Carisa Copper and Gold Mining Company, Ajax Mining Company, Eagle and Blue Bell Mining Company, Victoria Mining Company, Godiva Mining Company, Ridge and Valley Mining Company, Tintic Iron Company, Swansea Mining Company, Laclede Mining Company, Black Jack Mining Company, United Sunbeam Mining Company, Star Consolidated Mining Company, Silver Park Mining Company, Tesora claim, Mount Vernon Mining Company, Undine, Snowflake, Brooklyn, Victor, Bullock, South Swansea, and Primrose claims.

The Ajax Mining Company, in its annual report for the year ending October 1, 1907, gave the amount of development work as 931 feet during that year. The management has been confining the development mainly to the 1,000-foot level. Shipments were made during the year amounting to 8,091 tons of ore, which averaged 2.2 per cent of copper, and 3.7 ounces of silver, and 0.10 ounce of gold per ton. The general average of the metal content of the ore is low, caused by a clean-up of the ore from the old stopes and on the surface. The Carisa mine produced 196 cars of ore during 1907, amounting to

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[a] Folio No. 65, Geologic Atlas U. S., U. S. Geol. Survey, 1900, p. 5.

7,481 tons, averaging 0.7 ounce of gold, and 5.12 ounces of silver, per ton, and 5.18 per cent of copper. The development work consisted of 1,048 feet of drifting and crosscutting, and 368 feet of raises. Most of the ore produced came from the Northern Spy and Carisa claims. In the Spy property the ore was taken from all the levels down to the seventh, and in the Carisa property the ore was mined from the 50-foot to the 500-foot levels, inclusive. The Spy shaft is 800 feet deep, and the deepest workings in the Carisa are at 700 feet. The Centennial-Eureka mine produced in 1907 a siliceous copper, gold, and silver ore, containing small quantities of lead; it amounted to 104,916 tons, averaging about $30 gross, or equal parts in value for the gold, silver, and copper. The 1907 output is an increase of 18,496 tons over that reported for 1906. The vertical shaft is 2,144 feet deep, the same as in 1906. A drift driven south from the shaft on one of the upper levels about 9 years ago encountered the great ore body, a replacement chimney in limestone, which is thus far the largest found in the district, and has been followed vertically for more than 1,000 feet. It is 350 feet long and 100 feet wide, pitching about 50° southward. The Gemini Mining Company, during the latter part of the year, opened up an important body of ore between the 1,700-foot and the 1,800-foot levels. From the fact that its surface elevation is lower, the workings of this mine are deeper than any others in the district. Water level has been reached at 1,700 feet, and the ore below is found to carry increased copper values as depth is attained. The pumps are handling about 60 gallons of water per minute. The company shipped 197 cars of carbonate lead ore, taken from above the 1,700-foot level, and paid $100.000 in dividends during 1907. This makes a total of $2,000,000 paid by the company. The Bullion Beck and Champion mine continued to be a producer under the lease system, and of the 248 cars of ore shipped during the year the larger portion was carbonate lead ore, and much of it came from the 700-foot level. Dividends were paid amounting to $30,000, which makes the total paid by the company $2,668,400. The Silver Park mine was developed during 1907. The shaft is 350 feet deep, and a surface drift is 700 feet long. A small production resulted. From the Eureka Hill mine 200 cars of ore were shipped, taken out of the property by a number of lessees. Dividends estimated at $100,000 were paid, making a total of $1,950,000 since the company was organized. The Laclede mine shaft is 500 feet deep, with levels at each 100 feet. It produced 27 cars of ore in 1907. The vertical shaft of the Godiva mine is 900 feet deep. Most of the lead ore taken out, which was low grade, was treated in the 20-ton concentration mill on the property. There were 9 cars of lead concentrates shipped, containing gold and silver. The lower Mammoth mine has a vertical depth of 1,800 feet. Ore was mined between the 1,500-foot and the 1,700-foot levels, and shipments made consisted of 235 cars. Dividends were paid during the year amounting to $53,073, which makes the total paid by the company $63.073. Late in the year the property was equipped with an electric hoist, which handles the product to the 1,200-foot level, and with an auxiliary hoist from that level down to the 1,800-foot station. The Mammoth mine shipped 587 cars of crude ore, containing gold, silver, copper, and lead in 1907. The shaft is at a depth of 2,300 feet and continues to be the deepest one in the district. Shipments of ore at the greatest depth contained 3.6 ounces of gold, and 2 ounces of silver per ton. Some ore shipped from the 2,260-foot level averaged 11 per cent in copper. One shipment of 20 tons returned 144 ounces in gold per ton. Dividends amounting to $80,000 were paid during 1907, which makes the total sum $2,180,000. The old mill, formerly used for ore treatment, was dismantled late in the year and the timbers used in the mine. The Eagle and Blue Bell mine during 1907 made shipments of ore amounting to 227 cars, against 296 cars the year before. The ore contained gold, silver, copper, and lead. The shaft of the mine is 1,100 feet deep. The Star Consolidated mine shipped 7 cars of crude ore containing lead, with gold, silver, and copper. This property is now consolidated with that of the Black Jack Mining Company. The South Swansea mine produced 3 cars of lead sulphide ore, with iron sulphides. The shaft is 800 feet deep. The Swansea mine produced 46 cars of crude ore, containing chiefly silver-bearing galena, pyrite, and quartz. It is developed by a shaft 1,050 feet deep, but is filled with water to within 650 feet of the surface.

The main veins in the Swansea mine, and in its neighbor, the South Swansea, have a northerly strike, a dip of over 80° and they average 3 feet in width. The lead carbonate ores extended to a depth of about 250 feet, and changed at that depth into a barren pyrite, which continued for 100 feet in depth, when galena made its appearance, forming a permanent ore to the water level at 650 feet from the surface. The Uncle Sam Consolidated Mining Company owns the Humbug, Cyrus-Oliver, and four-fifths of the Richmond-Anaconda group of claims, adjoining the Humbug, and 400,000 shares in the May Day property. The shipments consisted of 192 cars of crude ore, and dividends were paid amounting to $70,000 during 1907. This makes a total paid from the Uncle Sam property and its May Day holdings of $200,000. The mine is developed to a depth of 500 feet by an incline shaft. A drift on the 260-foot level follows a bedding of the limestone, highly mineralized, to the east 170 feet, encountering a large ore deposit, which has provided a constant supply of shipping ore, containing 0.10 to 0.50 ounce of gold, 10 to 50 ounces of silver per ton, 0.10 to 0.18 per cent of copper, and 5 to 50 per cent of lead. On the 260-foot level, at a point 50 feet north, an incline shaft has been started to intercept another ore deposit. The mineral solutions seem to have followed along certain favorable beds of limestone, and at the intersection of a fault or fissure ore deposits of considerable magnitude have formed. The Colorado mine, which is one of the new properties to begin shipping in 1907, is located on the east slope of the Godiva Mountains. The ore, which is chiefly a silver-bearing lead carbonate, was encountered at a depth of 250 feet. The ore body trends northerly and southerly and in places is known to be 40 feet wide. From the bottom of the shaft the ore is reported 490 feet to the south, and to the north a distance of 280 feet. At a distance 750 feet north of the first shaft a second one has been completed to 250 feet in depth in limestone. Shipments of ore were made to the smelters in Salt Lake City in 1907 amounting to 257 cars of varying weight. The ore averaged $6 in gold and 93 ounces of silver per ton and 35 per cent of lead. Dividends were paid in 1907 amounting to $620,000. The

Beck Tunnel property began as a producer two years ago and continued to ship an even grade lead ore, which averaged about $50 net per ton during 1907. The ore is mainly a carbonate, with some galena, and of this character of ore 411 cars were shipped. All of the ore was taken from the 300-foot level, which is the total depth of the shaft, and a drift was driven 300 feet east where the ore body was encountered. For many feet along this ore deposit timbers 4 and 5 sets in width and 6 and 7 high are in evidence. About 1,000 feet north of the first shaft the company is sinking a new one, which, in December, was over 250 feet deep. The company paid dividends amounting to $340,000 in 1907, which makes a total of $940,000 paid since operations began. The Grand Central mine produced during the year a total of 284 cars of ore, containing silver, lead, and copper. Dividends were paid during 1907 amounting to $147,500, which makes the total paid since the beginning of operations amount to $1,306,250. Development work consists of a shaft, which has been sunk to a depth of 2,000 feet, and from the various levels drifts have been run covering a distance of about 5 miles. The ore and supplies are handled over an aerial tramway 1 mile long. The Victoria mine, under the Grand Central Mining Company's management, paid $30,000 in dividends during 1907, making the total paid since the beginning of operations $142,500. There were shipped during the year 85 cars of ore. The Tintic Iron Company, operating the property known as the Dragoon mine, shipped 292 cars of iron ore, used for flux at the Salt Lake Valley smelters. A double compartment prospecting shaft is down 600 feet. It is the intention to sink deeper during the coming year. A great deal of interest has been developed in the section occupied by this property since the recent discoveries in the Colorado and Beck Tunnel properties. The analysis of the iron ore shows that in composition it is not unlike the direct oxidization of pyrite in the ore bodies of the deposit in limestone, and the hope is entertained that exploration at depth will disclose rich secondary deposits beneath the iron capping. The May Day Mining Company produced and shipped from its property 221 cars of ore containing 0.03 to 0.16 ounce of gold and 11 to 30 ounces of silver per ton and 15 to 47 per cent of lead. A shaft has been sunk 800 feet with the intention of continuing 150 feet deeper. The total development work will aggregate 26,400 feet. The milling plant is one of interest in the concentration of cerussite ore. It has been enlarged to treat 65 tons of ore per day, is equipped with tables and Harz jigs, and treats an ore averaging 6 per cent of lead with a little copper in a quartz and limestone gangue, of which a large reserve remains in the old slopes of the mine. A marketable concentrate, containing about 30 per cent of lead, is secured. The company owns the Uncle Sam, Inis, Humbug No. 2, and Cory fraction claims. Dividends were paid amounting to $64,000 in 1907, bring the total paid to $94,000. The Yankee Consolidated Mining Company has developed its property by an incline shaft 500 feet deep and an adit about 1,900 feet long. Crude ore, containing lead and silver, was shipped to Colorado. Other properties on which development work is progressing, and which are likely to be producers in 1908, are the Sioux Consolidated, Iron Blossom, Crown Point, Black Jack, Iron, Standard, and East Tintic.

MORGAN COUNTY.

Argenta district.—The Carbonate Hill Mining Company did a small amount of development work on its property and shipped lead ore containing silver.

Morgan district.—The Chicago-Utah Copper Mining Company developed its property by an incline shaft 45 feet deep and a surface drift 160 feet long. The ore shipped contained copper and silver.

PIUTE COUNTY.

Gold Mountain district.—The Annie Laurie property, operated by the Gold Mountain Consolidated Mining Company, is developed by an adit 4,000 feet long. The mill, equipped for dry crushing and cyanide treatment followed by plate-amalgamation, has a daily capacity of 200 tons. The property was operated nearly the entire year, but closed down occasionally for repairs on the mill. Shipments of gold and silver bullion were made to San Francisco. The Sevier Consolidated Mining Company operated part of the year and produced gold and silver bullion. The company went into the hands of a receiver during the latter part of the year. The mine and mill are equipped with electric power generated by the company plant on the Sevier River.

Mount Baldy district.—The Pluto Mining, Milling and Smelting Company, operating the Clyde group, opened up a large deposit of copper ore in limestone, and made several important shipments of ore, which contained silver.

Ohio district.—The Webster Mining Company's property, operated by lessees, produced ore containing lead and silver. The Roosevelt Gold and Silver Mining Company operated the Branch mine, from which lessees took a small quantity of ore, containing copper and silver.

SALT LAKE COUNTY.

Big and Little Cottonwood districts.—From these two districts 19,896 tons of ore were shipped, having a total value of $622,568 for the gold, silver, copper, and lead content. This production came from 11 properties, an increase of 1 as compared with the number in 1906. The ore decreased 905 tons, as compared with the output of 1906, while the value increased $34,634. The gold and silver are contained principally in the lead ores. The Blue Point Mining and Milling Company, with property in Big Cottonwood district, did mostly prospecting work on its property, which is developed by 6 surface drifts from 65 to 230 feet in length. The Copper Apex Mining Company has developed its property by an incline shaft 175 feet deep and by 1,500 feet of crosscutting during 1907. The ore shipped from the property carried a good percentage of lead, with some copper and silver. The property of the Maxfield Mining Company continues to be operated by lessees. The ore averages well in lead and silver.

In the Little Cottonwood district the Columbus Consolidated Mining Company, during the year 1907, produced and shipped 6,689 tons of first-class ore, yielding at the smelter $259,359, or an average value per ton of $38.77 for gold, silver, copper, and lead content. There were also mined 10,569 tons of milling ore, having a gross average value of $11.38 per ton. The milling ore produced 3,216 tons of concentrates, which include 227 tons on hand December 31, 1906, for which the company received $89,770, or $27.91 per ton. The ratio of concentration was 3.3 tons into 1, and the saving 83 per cent. The cost of milling was $2.30 per ton, divided as follows: Operating, $1.14; improvements and construction, 82 cents; repairs, 34 cents. Work has been commenced on a drainage adit about 4,000 feet down the canyon from the property. This adit is completed for a distance of 333 feet, but was discontinued in November, owing to general financial conditions. Dividends were paid during 1907 amounting to $212,623. The development work in the mine consisted of 2,603 feet of drifts and crosscuts, 374 feet of shaft sinking, and 443 feet of raises, making a total development of 3,420 feet. The Flagstaff property, owned by the Consolidated Flagstaff Mines Company, produced lead-silver ore. The City Rocks Mining Company made important shipments of copper-lead ore, containing silver and small quantities of gold. The Emma Company (Limited) made test shipments of lead ore. The property of the South Columbus Consolidated Mining Company produced lead-copper ore, containing silver, and the Columbus Wedge Mining Company accomplished about 500 feet of development work on its property during 1907 and made shipments of silver-lead ore.

West Mountain (Bingham) district.—Extensive developments of the great bodies of monzonite porphyry by the use of steam shovels and the completion in February of an extra line of railroad into Bingham by the Rio Grande Western Railway, also the building of aerial trams on several properties, characterized the year's operations in the district. The miners of Bingham camp commenced the discussion of higher wages and waited on the various mine managers about the time the curtailment of copper began. The dropping of a large force of miners at the Boston Consolidated had the effect of putting an end to the agitation. The employees at the mine were given a voluntary advance of 10 per cent during the early part of 1907, which it was understood would remain in effect while copper stood at 18 cents or better per pound.

Production of gold, silver, and associated metals in West Mountain or Bingham district, Salt Lake County, Utah, in 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or Decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	78,986.02	$1,632,786	75,730.24	$1,565,483	− 3,255.78	− $67,303
Silver ....do....	1,927,350	1,291,325	1,786,580	1,179,143	− 140,770	− 112,182
Copper ....pounds..	39,424,276	7,608,885	45,431,964	9,086,393	+6,007,688	+1,477,508
Lead ....do....	22,927,661	1,306,877	21,971,064	1,164,466	− 956,597	− 142,411
Total..................	....	11,839,873	....	12,995,485	....	+1,155,612

West Mountain district gained only in its copper output for 1907, an increase of 6,007,688 pounds, valued at $1,477,508. This increase in value helped to swell the total value for 1907 of gold, silver, copper, and lead to $12,995,485, which is $1,155,612 greater than in 1906.

The tonnage of ore mined increased 506,961 tons, while the average value per ton decreased from $11.88 to $8.65. This increase in tonnage and decrease in value is due entirely to the output of monzonite porphyry ores of low grade mined for copper by 2 of the mining companies with steam shovels. In 1907 the producers reporting numbered 29, an increase of 4 over those reporting in 1906. The district ranks first in tonnage of ores and copper production and third in the output of lead for the State of Utah. The tonnage of crude ore mined and treated amounted to 1,503,082 tons, 49 per cent of which, or 737,459 tons, was ore treated in concentration mills, producing concentrates amounting to 50,115 tons. Crude ore shipped to smelters amounted to 765,623 tons. The concentrates contained 8,441.91 ounces of gold, 254,598 ounces of silver, 16,030,488 pounds of copper, and 6,500,745 pounds of lead. The total tonnage of ore produced in the district is divided according to metallic content into 1,398,466 tons of copper ores, 104,052 tons of lead ores, and 564 tons of copper-lead ores. No siliceous or zinc ores were reported. Included with the copper ore are 674,345 tons of mozonite porphyry mined chiefly for its copper by steam shovels and treated in concentration mills, which produced 24.6 per cent of the total copper output of Utah, or 15,827,574 pounds, 5,576.83 ounces of gold, and 51,723 ounces of silver, or an average recovery per ton of ore treated of 23.47 pounds (1.17 per cent) of copper, 0.008 ounce of gold, and 0.077 ounce of silver per ton. This class of ore constituted 44.8 per cent of the total tonnage of the district, and was the source of 23.7 per cent of the gold and 7.3 per cent of the silver recovered. Also included with copper ores are 355,872 tons of pyritic ore, or 23.6 per cent of district tonnage, and 38 tons of oxidized iron ore mined from replacement deposits. The sulphur content of the pyritic ore was about 20 per cent. There was recovered from this ore 12,049,569 pounds of copper, 15,951.17 ounces of gold, and 206,186 ounces of silver, or an average per ton of 1.69 per cent of copper, 0.045 ounce of gold, and 0.58 ounce of silver.

The sulphide copper ores, amounting to 368,229 tons, or 24.4 per cent of the district tonnage, yielded per ton 0.093 ounce of gold and 2.16 ounces of silver; and produced 45.6 per cent of the gold and 44.6 per cent of the silver. The lead ores, also mainly sulphide, forming 17.1 per cent, or 104,578 tons, of the district tonnage, averaged per ton 0.069 ounce of gold and 5.27 ounces of silver, and contained 9.5 per cent of the gold and 31 per cent of the silver.

The producers of the district, named in order of value of their production, are: Utah Consolidated Mining Company, Utah Copper Company, Boston Consolidated Mining Company, United States Mining Company, Tintic Mining and Development Company, Bingham Consolidated Mining and Smelting Company, Bingham-New Haven Mining Company, Utah Apex Mining Company, Phoenix Mining Company, Ohio Copper Company, Nevada-Utah Mines and Smelter Corporation, New England Gold and Copper Mining Company, Fortuna Mining Company, New Red Wing Gold Mining Company, Sampson Mining Company, Bingham Central-Standard Copper Company, Silver Shield Mining and Milling Company, Aztec Mining Company, Butler Liberal Mining Company, United Bingham Mining Company, Conglomerate Mining Company, Utah Bingham

Mining Company, Bingham Butte Copper Company, Inter-Mountain Mining and Industrial Association, and Bingham Mary Copper Company.

The Utah Consolidated Mining Company, in its published report for 1907, shows that there were mined during the year 271,332 tons of sulphide copper ore and 1,734 tons of lead ore. The copper ore was shipped to the company's smelter and the lead ore was sold in the open market. The smelter treated 272,989 tons of sulphide ore and 6,653 tons of custom ore, an average of 747.9 tons per day of sulphide ore. The product of the ores was 14,376,039 pounds of copper bullion, which when refined yielded 13,987,551 pounds of fine copper, 390,296.13 ounces of fine silver, and 34,554.88 ounces of fine gold. Of this refined product the custom ore yielded 98,863 pounds of fine copper, 6,149.29 ounces of fine silver, and 444 ounces of fine gold. In 1907 exploring and development work amounting to 10,120 feet was performed. On the 6½ level a large deposit of copper sulphide ore was encountered, from which 36,009 tons have already been extracted and shipped. On the No. 6 level another ore body has been developed, making into a flat deposit and promising a good tonnage. The lead ore produced and shipped came from No. 5 level, where there still remains considerable ore. The tonnage of copper sulphide ore now in sight is estimated at 1,202,930 tons. The property is being equipped for the operation of electric locomotives, which will replace horses for tramming. In December a decision of the United States Circuit Court of Appeals was rendered, which had the effect of closing down the company's smelter, and it went out of commission on January 1, 1908. Shortly after the company made a contract with the Garfield Smelting Company for the treatment of 800 tons of ore per day, which is about 7 per cent a year more than the amount the company treated at its own smelter during 1906 and 1907. In 1907, 1,600 acres of land were purchased for a new smelter site in and below Pine Canyon, Tooele County, and a distance of 3.7 miles northwest from the mines at Bingham. Plans and specifications have been completed for the new smelting plant, providing for a daily treatment of 1,500 tons.

The Utah Copper Company, according to a published statement, treated at its Copperton and Garfield concentrating plants from July to December, 1907, monzonite porphyry ores from its mines amounting to 549,819 tons, producing 13,022,080 pounds of copper, or 23.6 pounds, equivalent to 1.18 per cent, to the ton of ore, at an average cost per pound of 8.93 cents. As the percentage of steam-shovel ore increases this cost will be reduced. The Utah Copper Company was organized in 1903. The development of the mine was commenced in November of that year, and its mill, known as the Copperton plant, erected for experimental purposes, began operations in April, 1904. This plant has been enlarged and improved from time to time, and now has a capacity of 800 tons of ore per day. It is located about 3 miles down Bingham Canyon from the mine. The early developments of the mine were designed to open the ground for the application of the "caving system" of mining, and up to June, 1907, all of the ore was extracted in this way. In the summer of 1906 it was decided to adopt steam shovels, and since the commencement of this operation 700,000 cubic yards of capping have been handled, uncovering the equivalent of about 6 acres of ore. The mine has been developed by approximately 90,000 feet of underground workings, but very little such development has been done since January, 1907. The operations of the steam shovel have proven so satisfactory and economical that underground mining is being abandoned as rapidly as possible. The ore bodies of the property consist of an altered porphyry containing small grains of pyrite and chalcopyrite, very uniformly disseminated throughout the mass, both in fractured seams and in the body of the rock, an average of about 2 per cent copper, 0.15 ounce of silver, and 0.015 ounce of gold. It is stated that 34 per cent of the total tonnage extracted is coming from underground mining by the "caving system," practically all of it from the north side of the canyon, and 66 per cent from steam-shovel operations. The equipment at the mine consists of 15 steam locomotives, 6 steam shovels, 4 of which are 100-ton machines and 2 70-ton; 125 stripping dump-cars of 6-yards capacity, and 5 electric locomotives. At the Garfield mill of the company the first two units of 500 tons each were put in regular operation July 15, 1907, the fifth section August 17, the sixth September 1, the seventh November 2, the eighth on December 18, making a combined capacity of 4,000 tons per day in commission at the close of 1907. This plant will have when completed a capacity of 6,000 tons of ore per day. It is constructed of steel and concrete in 12 complete sections of 500 tons, each provided with independent driving motors. The general dimensions of the main building are 600 by 508 feet. The plant is divided into 3 departments—for coarse crushing, fine crushing, and concentrating. The coarse-crushing department consists of 2 sections of a capacity of 3,000 tons each in 16 hours. Each coarse-crushing section is equipped with 2 No. 7½ gyratory crushers and 2 belted rolls with diameter 54 inches and with face 20 inches. In this department the ore is crushed dry to three-fourths-inch size. The fine-crushing department contains thirty-six 6-foot Chilean mills and twenty-four 36-inch diameter by 16-inch face belted rolls. In this department the ore is crushed wet to 40 mesh. The concentrating department contains 72 single 2-compartment 20-inch by 30-inch Harz jigs, 48 Wilfley tables, and one thousand one hundred and four 6-foot vanners of the suspended type, together with necessary elevators, classifiers, and settling tanks. There are twenty-four 4-compartment classifiers and three hundred and eighty-four 9-foot conical settling tanks. The total area covered by the main mill building and ore bins is approximately 7 acres. The receiving bin, to which ores are brought from bottom-dump railroad cars, has a capacity of 25,000 tons; the receiving bin for coarse-crushed ore approximately 15,000 tons—a total storage capacity of 40,000 tons, or about 7 days' supply for the plant. Water is supplied to the mill from a 5,000,000-gallon concrete reservoir, located on an elevation higher than the plant. The water is pumped to this reservoir from springs located near the power plant. The power plant has a boiler capacity of 12,000 horsepower, made up of water tube boilers of 600 horsepower each, set in pairs. Generating equipment consists of 5 cross-compound condensing engines, 2 of 1,200 kilowatts each, and 3 of 2,000 kilowatts each, all connected direct to 100-revolution, 4,000-volt alternating-current generators. Current is transmitted to the mill at the generator potential and transformed to 440 volts for distribution about the plant. Power for the Bingham mines and Copperton mill is transmitted by a 15-mile line at 40,000 volts, which is transformed down to 440 for use by the induction motors.

The Boston Consolidated Mining Company, according to its annual statement to stockholders, produced and shipped during its fiscal year ending September 30, 1907, 134,305 tons of sulphide ore, containing 12,642.46 ounces of gold, 78,128.91 ounces of silver, and 6,146,925 pounds of copper. The cost of producing the copper averaged 8.65 cents per pound. The cost of mining this ore, including development, was $314,584.68, or $2.34 per ton; transportation to smelters, $67,755.78; smelting, $354,400.43; freight and refining charges upon bullion, $94,734.54; total, $834,475.43. On June 24, 1906, the first steam shovel to operate in the Bingham mines commenced digging, and since that time 3 others have been added. During the year these shovels stripped and removed 2,011,733 tons of capping. There was expended for these services, including supervision, drilling, railway operating, repairs, machine-shop expenses, and water line expenses, the sum of $215,107 for labor, or a labor cost of 10.69 cents per ton. There was expended for explosives, fuel, and other material involved in the operation, the sum of $152,177, or 7.56 cents per ton, making a total cost of 18.25 cents per ton for mining, removing, and disposing of the capping. At the beginning of 1908 the first 3 units of the mill were put into operation, each unit capable of treating about 230 tons of ore per twenty-four hours. The entire plant is divided into 13 units, which have a total capacity of approximately 3,000 tons per day. Each unit is equipped with twenty-four 1,500-pound Nissen stamps; four 3-compartment classifiers; 12 conical settling tanks of the Callow type; 22 Wilfley tables; 12 slime settlers; and eighteen 6-foot Johnston vanners, making for the plant a total of 312 Nissen stamps, 52 classifiers, 156 cone settlers, 286 Wilfley tables, 156 slime settlers, and 234 Johnston vanners. The ore is hauled from the mine at Bingham in 50-ton steel gondola cars in trains of 30 cars and dumped into a bin of a capacity of 14,000 tons. From this bin the ore is carried by conveyor belts to the crusher plant, which is equipped with 4 Gates rotary crushers, and from the crushing plant the ore is taken by conveyors to the top of the main mill bins, which have a capacity of 16,000 tons. The crushed ore is fed to the stamps automatically and reduced to 28-mesh size. The pulp is passed to the classifiers, where it separates into three divisions, passing thence to the various machines for the recovery of the product. During 1908 it is estimated that 600,000 tons of ore may be treated and produce 14,000,000 pounds of copper, and the mill, when once completed, will handle 1,000,000 tons of ore per year, producing 23,000,000 pounds of copper.

The United States Mining Company reports having extracted during 1907 from its Bingham properties 97,321 tons of ore. Owing to the injunction gotten out by the farmers against the smelting plant, these properties were not extensively worked during the latter half of the year. The property is equipped with an aerial tramway, which connects the mines with the railroad bins, 11,000 feet distant.

The Yampa Smelting Company in November, after closing down, commenced work on repairs and enlargement of its smelter, increasing the capacity from 400 tons to 750 tons of ore per day. The Tintic Mining and Development Company installed at the mine an electric power equipment and completed the 12,000-foot aerial tramway connected with the Yampa smelter.

The Bingham New Haven Mining Company produced and shipped ore and carried on development work in its mine during 1907. The lower adit was finished during September, and at a point 870 feet from the portal the vein was crosscut for 128 feet. This work was begun in October and remained unfinished at the close of the year.

The Utah Apex mine is developed by an incline shaft 500 feet deep and by a tunnel 2,800 feet in length. The property is equipped with an aerial tramway 3,000 feet in length, which was put into operation in February. Shipments of high-grade ore to the smelter aggregated 100 tons per day, while 200 tons of low-grade ore per day were mined and shipped to the Markham Gulch mill.

The Markham Gulch Milling Company completed its 200-ton concentrating mill in May. The mill is owned jointly by the Utah Apex and the Utah Development Company.

The Ohio Copper Company's property is located a mile and a half from the terminus of the Rio Grande Railway, and covers 1,600 acres, which includes the mill site, located about 3 miles from the mine. The developments of the mine extend to 500 feet in depth below an old adit driven from Bingham Canyon. It is reported that these developments have exposed a large body of low-grade copper ore. To work this body of ore, the main transportation adit is expected to cut it at a vertical depth of 520 feet below the deepest present development of the mine. During 1907, 2,920 feet of drifts and crosscuts in ore have been driven on the Cunningham adit level. This, together with 660 feet of raises and 1,900 feet of sublevels above, has blocked out and made ready for immediate extraction a reported immense tonnage of concentrating ore above this level. The development has been planned with a view to cutting up the ground into blocks approximately 100 feet square, by driving sublevels 25 feet apart from raises at the corners of these blocks, rendering the same amenable to mining by the caving system. No work was done between the Cunningham adit level and the 400-foot level. On the 400-foot level about 700 feet of drifts and crosscuts in ore have been driven. The 500-foot level, being the deepest and most interesting, because of what it might prove in showing the continuity of ore with depth, has had 3,230 feet of drifting and crosscutting in ore, and 852 feet of raises connecting with the 400-foot level above. The development work includes the sinking of a new shaft from the surface to a connection with the 500-foot level, which will be continued through a connection with the main transportation adit 520 feet vertically below. During the last three years the company leased a large mill, which stands on the Winnemuck mine in Bingham Canyon. Its capacity was about 150 tons of ore daily, and it was used as an experimental plant in working out details for a new mill started during the latter part of 1907. The plant will have a capacity of 2,000 tons of ore daily, and is to be equipped with 6 jaw crushers, 8 rolls, 144 jigs, 16 Chilean mills, and 382 Wilfley tables. The slime plant will be equipped with 72 Wilfley slime tables, 180 Callow tanks, and 12 buddles. The mill will be divided into 4 independent sections, driven by separate motors. The company has estimated the cost of mining the low-grade porphyry ore by the caving system at 70 cents per ton. The cost of milling is placed at 50 cents per ton of crude ore, and the cost of smelting is placed at $3 per ton of concentrates.

The Last Chance mine of the Nevada-Utah Mines and Smelter Corporation made regular shipments of smelting ore and began the operation of its milling plant in May.

The New England Gold and Copper Company accomplished about 2,044 feet of development work. This mine is opened by 2 adits, each about 2,000 feet long. There were mined and shipped about 7,000 tons of milling and smelting ore during the year. The 50-ton lead concentrator was remodeled and added to during the early part of 1907. All work was discontinued November 15, 1907, when the smelters declined further shipments.

The Montezuma Mining Company made shipments from a raise from the 250-foot level, where a body of ore was encountered assaying high in lead and silver.

SUMMIT AND WASATCH COUNTIES.

The output of these counties is confined to the Park City region, which covers the mineral area. The production of metals in the region in 1906 and 1907 is shown in the following table:

Production of gold, silver, and associated metals in Park City mining region, Summit and Wasatch counties, Utah, 1906 and 1907.

Metal.	1906.		1907.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	11,884.67	$245,678	8,413.52	$173,923	− 3,471.15	− 71,755
Silver ....do....	3,755,339	2,516,077	2,794,552	1,844,404	− 960,787	− 671,673
Copper ....pounds..	1,194,216	230,484	945,722	189,144	− 248,494	− 41,340
Lead ....do....	46,511,176	2,651,137	36,234,757	1,920,442	−10,276,419	− 730,695
Zinc..................do....	3,518,139	214,607	258,784	15,268	− 3,259,355	− 199,339
Total	....	5,857,983	....	4,143,181	....	−1,714,802

The gold and silver originated chiefly in the lead ores, and their production from this source for the last six years is as follows:

Production of gold and silver contained in lead ores in Uinta or Park City district, Summit and Wasatch counties, Utah, in 1902, 1903, 1904, 1905, 1906, and 1907.

	1902.	1903.	1904.	1905.	1906.	1907.
Gold............fine ounces..	15,025	14,744	13,643	14,807	11,884.66	8,413.52
Silver ....do....	7,967,296	6,835,908	5,814,386	3,998,165	3,755,339	2,794,552

The Park City region shows a decline of $1,714,802 as compared with the output of 1906 in the total value of $4,143,181 of all metals produced in 1907. The tonnage of ore mined decreased 29,164 tons and the average value per ton from $22.12 to $17.58. In 1907 there were 15 producers reporting, 1 more than in 1906. Of the 235,628 tons of ore produced in 1907, 75.6 per cent was treated in concentration mills, the remainder being shipped crude to smelters. The 3 concentration mills, at the Silver King, the Daly West, and the Daly

Judge mines, and 4 small tailing plants on Silver Creek, treated a total of 185,002 tons of ore and tailings producing 34,679 tons of concentrates, containing 3,218.76 ounces of gold, 1,031,926 ounces of silver, 318,873 pounds of copper, 16,836,038 pounds of lead and 258,784 pounds of zinc, figured as spelter. The gross value of the concentrate amounted to $1,718,961, or an average of $49.56 for each ton of concentrate and $9.29 for each ton of crude ore and tailings handled by the concentrators. The crude ore shipped to smelters aggregated 50,626 tons, containing 5,194.76 ounces of gold, 1,762,626 ounces of silver, 626,849 pounds of copper, and 19,398,719 pounds of lead. The total gross value of the shipping ore was $2,424,220, an average value of $47.88 per ton. The ores mined are largely the sulphide and carbonate ores, which aggregated 229,333 tons, containing 8,340.55 ounces of gold and 2,772,109 ounces of silver. Siliceous ore, so called from its low content of lead, aggregating 72,065 tons, included the reconcentration of 6,712 tons of tailings on Silver Creek, part of which, classed as lead-zinc ore, produced zinc in addition to the gold, silver, and lead. The copper ore production was small, aggregating 1,270 tons, containing 54.91 ounces of gold and 1,067 ounces of silver. Producers of the region for 1907 were as follows: Silver King Coalition Mines Company, Daly West Mining Company, Daly Judge Mining Company, Little Bell Consolidated Mining Company, Daly Mining Company, Jupiter Mining Company, American Flag Mining Company, and 4 tailing plants on Silver Creek. The reports of the principal producers are summarized below.

In March, 1905, a serious cave-in occurred in the main Ontario adit causing the flooding of the lower workings of the Ontario, Daly, Daly West, and the 1,600-foot level of the Daly Judge. Work of opening the adit was immediately begun and has been actively continued since that time. At the time the cave-in occurred it was thought that but one portion of the adit had been damaged. It was subsequently found, however, that the adit was completely closed in a number of places. Owing to the poor character of the ground and the rapidity with which the water was rising in the mine, it was found impracticable to remove the débris and catch up the ground. The general system in opening up the adit has been to turn a " shoo-fly " or by-pass around the larger caved portions. After going around the first large cave-in, 6,000 feet from the portal, it was found that a second had occurred at a point about 14,000 feet from the portal; the débris of the first one was then removed and the adit opened up to the second. No attempt was made to remove this débris but the opening was securely bulkheaded and a " shoo-fly " of the same cross section as the adit started around the caved portion. During the year pumps were installed at No. 3 shaft to lessen the danger to the men working in the face of the adit. The restoration of the adit will enable the resumption of work on the lower levels of the principal mines of the district, which have been flooded since it was damaged. At the close of 1907 the drainage adit was being restored to its former usefulness, after having been closed for more than two years. At the beginning of the year the Ontario and the Daly West mines were closed on account of labor troubles. These were adjusted without serious loss to either employer or employee.

The operators and miners of Park City have agreed on a uniform wage scale, which went into effect on November 15, 1907. The reduction was from 25 to 50 cents per day. Henceforth engineers are to receive $4; timbermen, $3.50; all underground men, $3; millmen, $3; laborers and outside men, $2.75.

In November construction was commenced by the Grasselli Chemical Company, of Cleveland, Ohio, on a zinc plant, designed to treat Park City middling, and more especially the large dump, consisting of approximately 150,000 tons of zinc middling at the Daly Judge mill, averaging between 15 and 20 per cent of zinc. The initial capacity of the plant will be 50 tons, using Sutton and Steele dry tables. The site selected is near the Mackintosh Sampling Works.

In June, 1907, the Silver King Coalition Mines Company was incorporated for the purpose of merging the Silver King, Keith-Kearns, Magnolia-St. Louis, Pinyon-Ridge, Odin, Belmont, and other Park City milling companies, involving in all about 2,000 acres of ground. The mill of the Keith-Kearns company will be dismantled and moved to the site of the Silver King plant to increase the capacity of the latter about one-third. The total development work during 1907 was approximately 12,250 feet. The shaft is at a depth of 1,300 feet, and the Silver King mine of the company has a 300-ton concentrating mill in operation.

The Daly Judge Mining Company, in its annual statement, reports for 1907 the extraction of 76,914 tons of ore, 7,933 tons of which were shipped, and 68,981 of milling ore, which produced (at the ratio of 8.7 to 1) 9,625 tons of concentrates. The average assay of the crude ore shipped was 16.05 ounces of silver; 0.056 ounce of gold; 18.61 per cent of lead; 0.33 per cent of copper; 14.80 per cent of zinc; and 14.06 per cent of iron. The ore sold for $19.48 per ton. The concentrates assayed 16.30 ounces of silver; 0.058 ounce of gold; 31.08 per cent of lead; 0.19 per cent of copper; 7.98 per cent of zinc; and 21.27 per cent of iron; and sold for $29.10 per ton. Zinc middling, amounting to 169 tons, was disposed of at $3.43 per ton, the average assay of which was 6.3 ounces of silver; 0.025 ounce of gold; 3.70 per cent of lead; 26.13 per cent of zinc; and 19.15 per cent of iron. From 5,999 tons of iron middling, assaying 6.20 ounces of silver; 0.040 ounce of gold; 7 per cent of lead; 0.22 per cent of copper; 9 per cent of zinc; and 32.08 per cent of iron, returned a total of $48,149.30, or $7.96 per ton, the total ore sales bringing $492,790.14. The total metal production from the property for 1907 was 322,489 ounces of silver, 1,256.10 ounces of gold, 9,788,680 pounds of lead, and 116,793 pounds of copper. The company paid in dividends during the year $224,850. The mine development consisted of 3,147 feet. Of this 1,608 feet were drifts; 598 feet, crosscuts; and 941 feet, raises. Heretofore hauling in the tunnel has been by horses, but the installation of an electric haulage system was begun and this was to be in operation early in 1908. In the mill the more notable improvements of the year have been the jigging, sizing, and power departments. In the first, two 3-compartment Harz type jigs have been added to handle the tailings from the finer jigs and the over-size from the Callow screen, taking out lead-iron concentrates, high-grade zinc middling and quartz middling, and rejecting the worthless portion, thus diminishing the amount of material to be recrushed. For the fine sizing, 1 Wilfley table and 2 Callow duplex screens have been put in, thereby increasing the table capacity. The full capacity of the mill is 400 tons per day, but at present only from 210 to 250 tons are treated in two 8-hour shifts. The equipment consists of Blake crusher, Davis rolls, trommels, jigs, Callow screens, Huntington mills, and Wilfley tables.

The Daly West Mining Company, in its published report, gives the following information: During 1907 there were mined 54,634 tons of second-class ore from the Daly West mine and 8,585 tons from the Quincy mine, a total of 63,219 tons. The first-class ore amounted to 17,376 tons. In the Quincy mine the development work totaled 223 feet. Most of the ore was taken from above the 200-foot level. No work was done below this point, though large bodies of ore are said to be still available in this portion of the mine. In the Daly West mine development and exploratory work, as well as extraction of ore, was carried on from the 900-foot, 1,200-foot, 1,300-foot, 1,400-foot, and 1,550-foot levels. Most of the ore was taken from the first and the last of these. Fifty-three days were lost during 1907 on account of labor trouble. The milling plant operated 131 days and treated during that period 63,218.9 dry tons of ore. From this amount there were rejected by hand picking 2,746.9 tons of waste. Thus there were actually milled and sampled 60,472 dry tons, which produced 7,480 dry tons of concentrates, or a ratio of 8.08 tons of ore into 1 ton of concentrates. The mill treated during each 24-hour day service 479.7 dry tons of ore. The assay of the crude ore averaged 3.32 per cent of lead and 9.47 ounces of silver; the average of the tailings assayed 0.016 per cent of lead and 2.72 ounces of silver; the concentrates averaged 28.15 per cent of lead and 54.54 ounces of silver, 0.0408 ounce of gold, 1.53 per cent of copper, and 15.4 per cent of zinc. The improvements in the mill consisted of the addition of 9 fine ore tables, which have rendered excellent service.

The Little Bell Mining Company is developed by a vertical shaft 700 feet deep. The New York-Bonanza Mining Company has opened its property to a depth of 850 feet, 400 feet of which have been sunk vertically and the rest on a dip of 83°. The property of the Jupiter Mining Company was operated entirely by lessees, who took out lead ore carrying silver with traces of copper.

TOOELE COUNTY.

The county is credited with 17 producers, reporting 310,801 tons of ore in 1907, valued at $1,989,517, an average of $6.40 per ton. This is a decrease of 109,284 tons in quantity and an increase of 79 cents in value per ton. This increase is due to the increase in the output of silver and zinc. The gold yield amounted to 27,612.02 ounces, valued at $570,791 in 1907, as against 44,633.58 ounces, valued at $922,658 in 1906, a decrease of 17,021.56 ounces in quantity and $351,867 in value. The greater part of the gold production in 1907 was from the Consolidated Mercur mine. The silver produced amounted to 468,472 ounces, valued at $309,192, in 1907, as against 358,813 ounces, valued at $240,405, in 1906, an increase of 109,659 ounces and $68,787 in value. Copper decreased from 1,570,689 pounds produced in 1906 to 739,521 pounds in 1907, a decrease of 831,168 pounds in quantity and $155,239 in value. Lead increased from a production in 1906 of 13,347,160 pounds, valued at $760,788, to

13,518,601 pounds, valued at $716,486, in 1907, gaining 171,441 pounds in quantity and decreasing $44,302 in value. Considerable siliceous zinc ore was shipped from the Scranton mine in North Tintic district. Ore treated at gold and silver mills, where the treatment is entirely by cyanide process, produced gold bullion containing gold valued at $555,915, and 37 ounces of silver from the treatment of 201,436 tons of ore. At 3 concentration mills, the Honerine and the New Stockton in Rush Valley district and the Ophir in Ophir district, 83,393 tons of ore were treated, producing 26,883 tons of concentrates, which contained 423.69 ounces of gold, 288,894 ounces of silver, 699,768 pounds of copper, 7,723,492 pounds of lead, valued at $748.728, or at an average value of $27.85 per ton. Crude ore amounting to 25,972 tons shipped to the smelters contained 295.94 ounces of gold, 179,541 ounces of silver, 39,753 pounds of copper, and 5,795,109 pounds of lead, which, with the zinc from one mine, yielded a gross value of $684,850, or an average value per ton of $26.37.

Camp Floyd district.—The Consolidated Mercur Mines Company, in its published report for the year ending June 30, 1907, states that mining was retarded on account of floods from torrential rains and the loss of the sawmill by fire, in which a large part of the stock of mining timbers was stored, and the tramway motor house, burning both the electric locomotives. Besides these misfortunes, a fire broke out in the east stope and a snowslide destroyed the Telluride Power Company's flume, by reason of which the plant was wholly shut down for five days for want of power. The ore produced during the year amounted to 245,169 tons, of which 45 per cent was base ore and the remainder oxidized ore, which produced in gold $642,843.90, or an average extraction of $2.62 per ton. The tailing, according to the average for twelve months, assayed 98 cents. The mining costs for the year, including prospecting, repairs, and general expenses, were $354,422.09, or $1.45 per ton. The milling costs were $290,124.16, or $1.18 per ton. Accordingly, the total operating expense of the company, including all expenses except construction items, was $644,546.25, or $2.63 per ton of ore treated. At the mill operations were delayed on account of the shortage of coal for the roasting furnaces. There have been no radical changes made, except in the slime plant, which separates the sand from the slime, leaching the former and agitating and filtering the latter. It is calculated to treat 400 tons of slime per day. It was put in commission in September, and the results so far obtained show the extraction to be practically the same as in the experimental plant, the slime tailings averaging 45 cents in gold and the sand 48 cents. During the year the roasting department, operating on 110,069 tons of base ore, expended a total of $134,475.85, or $1.22 per ton, which paid for coal, 68 cents per ton; labor, 29 cents per ton; power, 6 cents per ton, and miscellaneous 19 cents per ton. In last year's report it was stated that lime was found to be more beneficial in the cyanide process than caustic soda for maintaining the alkalinity of the solution. For a short time the caustic soda was used with lime, but discontinued later in the year. Since that time it has been used only in emergencies. Some difficulty was found with the oxidized ore, owing to its slimy composition. This will be overcome in the new slime plant. The amount of chemicals consumed during the year per ton of ore was 0.66 pound of cyanide, 5.4 pounds of lime, and 0.05 pound of caustic soda. The latter was used at only brief intervals. In the precipitating department zinc dust has continued to give satisfactory results, but owing to the nature of the installation the precipitating costs have always been higher than in ordinary practice. The consumption of zinc dust averages 0.45 pound per ton of ore treated. The increase in this item is due to the fact that the high-grade domestic zinc dust, which was formerly used, is no longer obtainable, and it takes more of the inferior imported article to get the same results. The wage scale of miners in the Mercur district has always been $2.50 for hand drillers, $2.75 for machine men, and $2.50 for muckers and trammers, eight hours constituting a day's work. At the Mercur mine the wages have actually averaged much higher, as most of the men work by contract. The contracts during the year averaged $3.34 per shift. During the latter half of 1907 the miners of the camp were granted an increase in wages, which gave hand drillers $3, machine men $3.25, and muckers and trammers $2.75 per day. The Manning mill and tailings, located 3 miles south of Mercur, the property of the company, are leased on a royalty basis to the Holderman Filter Tank Company. The new plant was finished and put into commission late in July, 1906, and handles about 100 tons of tailings per day. During the fiscal year of the company it handled 19,682 tons, yielding a net revenue of $5,147.

The Sacramento Mining Company ceased shipping bullion and mercury in July, 1907, and since that time has been engaged in prospecting in the new portion of its property.

North Tintic district.—The Scranton Mining and Smelting Company owns 22 patented claims. The ore produced is shipped from Del Monte, on the San Pedro Railroad, 2 miles south from the property. Shipments consisting of 313 cars of lead and zinc ore were shipped in 1907, the lead ore going to the Salt Lake smelters and the zinc to eastern works. The development work consists of drifts and raises, and has been continued for 500 feet below the apex of the mineral deposit.

Ophir district.—The Buckhorn mine, the property of the Cliff Mining Company, is developed by 3 adits, 1,800, 1,600, and 1,200 feet in length, respectively. The property, which was an important producer for the past three years, has again commenced to produce regularly after a long period of preparation in putting the mine in shape to handle the ore economically. The new aerial tramway is in commission and transfers 50 tons of ore per day. The crude ore shipped to the smelter contained a high percentage of lead, considerable silver, and a small quantity of copper and gold. Shipments were also made from the Jay Bird, Chloride Point, Eureka Ophir, Hidden Treasure, Kearsarge, Queen of the Hills properties, and from some of the old dumps. The Ophir Hill Consolidated Mines Company operated its concentration mill, producing a lead-silver concentrate, which was shipped to the Salt Lake smelter. The crude ore carries a high percentage of sulphur and contains zinc and iron. It is not sorted and all goes through the mill. The ore occurs at intersection of a series of north-south fissures cutting the bedded limestone strata.

Rush Valley district.—The property of the Honerine Mining and Milling Company is situated about 1½ miles from the town of Stockton. It owns over 30 patented claims and is developed by an adit

11,000 feet long. During the year there were shipped from 8 to 10 cars of ore a month, which was mined by lessees on the property. Most of this ore was taken from the old stopes above the 600-foot level, a section of the property that had been abandoned by the company as being too dangerous to work in. In October the mine and mill ceased operations entirely on account of financial conditions.

The New Stockton Mining Company enlarged the concentrating mill, which now treats 150 tons of ore per day. The plant started in November. From the mine there has been shipped a number of cars of high-grade ore, which was taken out in developing the low grade deposits. The ore contains lead, silver, and a small percentage of copper.

The Lion Hill Consolidated Mining Company was organized in 1907, and the well-known properties, the Northern Light, Columbia, and Crown Point mines, worked by lessees during the year, will probably be developed by this company in the future.

The Honerine West Mining Company and the Silver Eagle Mining Company made shipments of lead ore, containing silver.

UINTA COUNTY.

The old Dyer copper mine in this county has passed into the possession of Wisconsin owners, who are taking steps to operate it again. The mine is equipped with a small smelter and has produced considerable copper in the past. The copper deposit occurs in sandstone, and mining was carried on formerly at shallow depths.

UTAH COUNTY.

From 1871 to 1874 the mines on Miller Hill, near the head of American Fork Canyon, were active, and the Sultana Smelting Works, belonging to the Miller Mining and Smelting Company, were operated, producing lead-silver bullion. The bullion was transported down the canyon by wagon until 1872, when the company built a narrow-gage railway to American Fork Station on the Utah Central Railway, now the San Pedro Railroad. In 1875 these mines and the smelter were idle, only occasional lots of ore being shipped from the Miller and other properties by prospectors and lessees. This condition lasted until 1905, when enterprising lessees began to make important shipments from the Miller and Wyoming properties. In 1907 the largest yield was recorded and this, added to the output of other mines in the county and those of the Tintic district, brings the county once more into prominence as a metal producer. The mines of the Tintic district lie close to the Utah-Juab county line, which is marked by the crest of the East Tintic Mountains, and Tintic district extends into Juab County, which embraces its most productive area. The mines on the Utah County side have been small but regular producers for a number of years, but its output was not materially added to until the Beck Tunnel mine began producing in 1906 and the Colorado mine in 1907. Utah County is fourth in total value of its metallic output and third only to Summit and Salt Lake counties in quantity of lead. The output of 21,823,587 pounds of lead, valued at $1,156,650 is greater by 11,051,684 pounds in quantity and $542,651 in value, than the output in 1906. Of silver there were 1,512,182 ounces, a gain of 998,700 ounces in quantity and $654,007 in value. Of gold, there were produced 8,551.78 ounces, an increase of 5,004.75 ounces in quantity and $103,457 in value; of copper, 45,098 pounds in quantity and $9,020 in value, which is a gain, since no copper was reported in 1906. The total value of the 1907 metallic output is $2,340,491, a total gain of $1,309,135. With 10 producing mines, as compared with 8 in 1906, there were mined 41,547 tons of ore, as against 19,955 tons in 1906, and an increase in value per ton from $51.68 to $56.33. With the exception of 2,520 tons of crude milling ore, all the ore was shipped to smelters. This amounted to 39,027 tons and consisted entirely of lead carbonate.

American Fork district.—The Surprise Mining Company made several shipments of lead ore containing silver. The Miller[a] mine was discovered in 1870, but not worked on a large scale until 1871. The deposit lies in limestone, near the contact with quartzite, and seems to follow the strike of the country rock. The ore deposits occur irregularly and the property was practically abandoned in 1874 as being worked out. At that time a large deposit of ore was exhausted, but it has been subsequently followed into the Wyoming claim belonging to the Miller company. It is in this claim that the operations have been continued with great success since 1905. The Wyoming or Miller group of claims, operated by lessees, was productive of lead ore with considerable silver and small quantities of copper and gold. The Pacific Gold Mining and Milling Company operated its Blue Rock property, which is developed by an adit 800 feet long and an upraise 165 feet. Shipments were made containing lead and silver. The mine of the Dutchman Mining Company was productive through lessees, who worked over the old dumps and surface works of the property. The Milkmaid property produced some lead ore, containing silver. The Mountain Dell Mining and Milling Company, operating the Imperial and Goodshall groups, has an incline shaft 300 feet in depth, and at the present time the property is being opened by surface level. The ore shipped carried a high percentage of lead and a quantity of silver.

Utah County also has within its borders 4 important silver-lead producers. These, however, are reported under the heading of the Tintic district of Juab County.

WASHINGTON COUNTY.

Harrisburg district.—The Free Coinage property of the Brundage Mining and Reduction Company, at Leeds, operated its 5-stamp amalgamation mill on free silver ore taken from the property.

Tutsagubet district.—The Utah and Eastern Copper Company operated its mine and smelter, producing a high-grade copper matte, which was shipped to eastern refiners. The property is developed by a vertical shaft 1,150 feet deep. The Black Warrior claim, operated by the National Development Company, was productive of lead ore containing silver. The Paymaster mine, operated by the Pay Roll Mining and Smelting Company, shipped some lead ore containing copper and silver.

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[a] Raymond, R. W., Mineral resources west of the Rocky Mountains, 1873, pp. 248.

WASHINGTON.

By Charles G. Yale.

PRODUCTION.

Reports sent in by 53 producers, of which 39 were deep mines and 14 placers, show that the production of gold, silver, copper, and lead in Washington for the calendar year 1907 was valued at $398,635. Of this total the gold yield was 12,532.70 fine ounces, valued at $259,074, and the silver was 55,359 ounces, valued at $36,537, or a total value for the two metals of $295,611, as compared with $252,386 in 1906, an increase in these two metals combined of $43,225. The tonnage of ore of different kinds mined showed an increase. Siliceous ore increased from 15,029 short tons in 1906 to 27,627 tons in 1907, or 12,598 tons. The largest increase came from Snohomish County, where the Monte Cristo Metals Company made the greatest output. Copper ore increased from 11,168 short tons in 1906 to 14,691 tons in 1907, a gain of 3,523 tons. Stevens County produced by far the largest proportion of this copper ore. Lead ore increased from 936 tons in 1906 to 2,095 tons in 1907, an increase of 1,159 tons. It all came from Stevens County. The average value per ton of gold and silver siliceous ore in 1907 was $9.13, which is much lower than this value in 1906; of copper ore the average value in gold and silver per ton was $1.13, and the average value of the silver in the lead ores was $2.27 per ton.

During 1907 there were treated at gold and silver mills in Washington 4,711 tons of ore, containing $24,883 gold and $268 silver. This was $5.28 per ton in gold and about $0.06 in silver, a total per ton of $5.34 in gold and silver. To concentrating mills 13,697 tons of crude ore were shipped, yielding $44,721 gold, $12,530 silver, and 352,663 pounds of lead. Crude ore sent to smelters in 1907 amounted to 26,005 tons and contained $167,610 in gold, or an average of $6.44 per ton, and $23,599 in silver, an average of 91 cents per ton. The average value in both gold and silver was $7.35.

The statement of production for 1906 and 1907, showing increase and decrease, and valued at each year's commercial prices, is as follows:

Production of gold, silver, and associated metals in Washington in 1906 and 1907.

Metal.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1906	10,722.22	$221.648	45.878	$30,738	235,030	$45,360	926,100	$52,787	$350,533
1907	12,532.70	259,074	55,359	36,537	297,812	59,562	820,035	43,462	398,635
Increase (+) or decrease (−).	+1,810.48	+37,426	+9,481	+5,799	+62,782	+14,202	−106,065	−9,325	+48,102

The production of ore in Washington in 1907 was 44,413 short tons, having an average value of $8.48 per ton in gold, silver, copper, and lead, as against 27,133 tons, having an average value of $12.21 per ton in 1906, an increase in 1907 of 17,280 tons in quantity and a decrease of $3.73 in average value per ton.

GOLD.

The total gold production of Washington in 1907 aggregated 12,532.70 fine ounces, valued at $259,074, as against 10,722.22 fine ounces, valued at $221,648, in 1906, an increase of 1,810.47 fine ounces in quantity and of $37,426 in value. The most productive county is Stevens, with $149,588 to its credit for the year, followed in order by Snohomish, Whatcom, and King counties, all of which made a yield of over $10,000. Of the total gold, $222,619 came from dry or siliceous ore in 1907, an increase of $29,363; $21,860 from placer mines, an increase of $2,651; and $14,595 from copper ores, an increase of $5,412. Increases are shown in the counties of Okanogan, Snohomish, Stevens, and Whatcom, the most appreciable being in Stevens County, which virtually doubled its output. This county made the largest gold yield from both siliceous ores and copper ores. The most productive placer mining county is Whatcom, followed by Kittitas. There are 5 productive placer mines in Whatcom County and 7 in Kittitas, but there are no very extensive ones in the whole State. The gold production from different kinds of ores, by counties, with the increase, is shown in the following table:

Source of gold production in Washington, by kinds of ore, in 1907, by counties, in fine ounces.

County.	Placers.	Deep mines.				Grand total.
		Dry or siliceous ores.	Copper ores.	Lead ores.	Total.	
Chelan		133.80			133.80	133.80
Ferry		76.92	118.13		195.05	195.05
King		500.44			500.44	500.44
Kittitas	329.09	91.09			91.09	420.18
Okanogan	19.59	409.83	25.01		434.84	454.43
Snohomish	24.19	2,163.38	13.69		2,177.07	2,201.26
Stevens		6,687.12	549.20		7,236.32	7,236.32
Whatcom	684.60	706.62			706.62	1,391.22
Total	1,057.47	10,769.20	706.03		11,475.23	12,532.70
Increase	128.23	1,420.44	261.80		1,682.24	1,810.47

SILVER.

The silver yield of Washington in 1907 was 55,359 ounces, valued at $36,537, as against 45,877 ounces, valued at $30,738 in 1906, an increase of 9,482 ounces in quantity and of $5,799 in value. The increase came altogether from Snohomish and Stevens counties. The largest quantity came from dry or siliceous ore in Snohomish county, that county increasing its silver output by 14,305 ounces. In Stevens County over 7,000 ounces came from lead ores and over 8,000 from siliceous ore, the total increase in that county for 1907 over 1906 being

10,728 ounces. Very little silver came from the placers and less than 3,000 ounces from copper ores. The following table shows the source of silver production, by counties and by classes of ore, in 1907, with increase or decrease:

Source of silver production in Washington, by kinds of ore, in 1907, by counties, in fine ounces.

County.	Placers.	Deep mines.				Grand total.
		Dry or siliceous ores.	Copper ores.	Lead ores.	Total.	
Chelan		53			53	53
Ferry		13,623	698		14,321	14,321
King		535			535	535
Kittitas	97	8			8	105
Okanogan	4	3,608			3,608	3,612
Snohomish	3	18,985	401		19,386	19,389
Stevens		8,024	1,871	7,205	17,100	17,100
Whatcom	108	136			136	244
Total	212	44,972	2,970	7,205	55,147	55,359
Increase (+) or decrease (−)	+71	+6,993	−4,208	+6,626	+9,411	+9,482

COPPER AND LEAD.

The output of copper increased slightly from 235,030 pounds, valued at $45,360, in 1906 to 297,812 pounds, valued at $59,562, in 1907—an increase of 62,782 pounds in quantity and of $14,202 in value. The largest production of any one county was in Ferry. Snohomish County came next, followed by Stevens and Okanogan, in order named.

Lead amounted to 820,035 pounds, valued at $43,462, in 1907, as compared with 926,100 pounds, valued at $52,787, in 1906, a decrease of 106,065 pounds in quantity and of $9,325 in value. The total output was derived from Stevens County, where there are 3 producers of lead, of which the Jupiter Lead Company, of Northport, is the largest.

PROGRESS OF MINING INDUSTRY IN WASHINGTON IN 1907.

There was an increase over 1906 in output of gold, silver, and copper in Washington in 1907, the total value of all these metals mined, including lead, having been $398,635. The tonnage of ore increased materially, but the average value per ton was lower in 1907 than in 1906. Not all the counties of the State showed an increase in output of gold, but Chelan, Okanogan, Snohomish, and Stevens counties did so, the greatest increase being in Stevens County. The increase in silver value for the year came mainly from Snohomish and Stevens counties. The copper increase was not very large and was mainly from Ferry County. The lead output was somewhat decreased in quantity and value.

There seems to be a very general complaint of long standing that lack of suitable transportation facilities retards progress in most of the important camps. In Chelan County the Entiat district made the largest yield in 1907, but at Blewett, mines not working in 1907 are expected to do so in 1908. Both Lakeside and Leavenworth districts expect to make a yield in 1908. In Ferry County the Danville mining district did well, but the Republic district had only a small yield, and numbers of mines were idle or abandoned, from lack of suitable transportation facilities and of cheap methods of treating the ores. At Kellar 2 smelters will be in operation in 1908. In King County a railroad has been completed to the Apex mine since the close of 1907. In the Liberty district, Kittitas County, the placers did not have any marked yield, but are expected to do better in 1908.

In Okanogan County there are large numbers of idle mines and but few producing mines, the latter being nearly all quartz. Chesaw has been the most productive district. Since the close of the year some new mills have been built in this district and a smelter is proposed. There is now a railroad station within a few miles of the principal properties in this district, so that ore is being shipped to smelters. In Snohomish County the copper mines did not do so well as in 1906; their output was lessened in 1907, as several properties were closed down. Monte Cristo is the most productive gold district. At Index the principal mine now has a 100-ton concentrator, with a reverberatory furnace, and will do custom work as well as handle its own ores; and another company at the same place has also a 100-ton concentrator with suitable accessories. Some mines at this place which were unproductive in 1907 will doubtless make a yield in 1908. Stevens County had the largest yield of the counties of the State, all from deep mines. Considerable development work is going on. At Bossburg 2 large companies, unproductive in 1907, have since become productive. In Chewelah district several mines have lately been reopened. There are several good producers in Deer Trail district. At Marcus copper is the principal metal, and at Northport lead ores are produced and shipped to Missouri. Metalline district is expected to make a good showing for 1908, as a 200-ton concentrating plant is being built for 2 mines, and a 50-ton plant for another mine. No increase was shown in the placer gold of Whatcom County, and the quartz yield fell off also.

Altogether there were only 53 producing mines reporting from Washington in 1907, of which 39 were deep and the rest placers. Reports showed also 469 known mines as virtually idle. To be made productive, most of these mines need the assistance of capital and suitable transportation facilities.

The following table shows the production of gold, silver, copper, and lead in Washington in 1907, by counties:

Production of gold, silver, copper, and lead in Washington in 1907, by counties.

County.	Producing mines.	Tonnage.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ounces.*		*Fine ounces.*	
Chelen	4	167	133.80	$2,766	53	35
Ferry	5	2,168	195.05	4,032	14,321	9,452
King	2	542	500.44	10,345	535	353
Kittitas	10	263	543.18	8,686	105	69
Okanogan	9	2,027	454.43	9,394	3,612	2,384
Snohomish	4	13,504	2,201.26	45,504	19,389	12,797
Stevens	12	23,122	7,236.32	149,588	17,100	11,286
Whatcom	7	2,620	1,391.22	28,759	244	161
Total	53	44,413	12,532.70	259,074	55,359	36,537

County.	Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Chelen					$2,801
Ferry	131,731	$26,346			39,830
King					10,698
Kittitas					8,755
Okanogan	26,200	5,240			17,015
Snohomish	74,837	14,967			73,268
Stevens	65,044	13,009	820,035	$43,462	217,348
Whatcom					28,920
Total	297,812	59,562	820,035	43,462	398,635

The total tonnage, by kinds of ore treated, in each county of Washington in 1907 is given in the following table, together with the increase or decrease as compared with 1906:

Tonnage of ore sold or treated in Washington in 1907, by kinds of ores and by counties, in short tons.

County.	Dry or siliceous ores.	Copper ores.	Lead ores.	Total.	Increase (+) or decrease (−) as compared with 1906.
Chelan	167			167	+ 164
Ferry	230	1,938		2,168	− 4,196
King	542			542	− 58
Kittitas	263			263	+ 235
Okanogan	1,810	217		2,027	+ 852
Snohomish	13,234	270		13,504	+ 9,711
Stevens	8,761	12,266	2,095	23,122	+10,852
Whatcom	2,620			2,620	− 280
Total	27,627	14,691	2,095	44,413	+17,280
Increase	12,598	3,523	1,159		
Average value per ton in gold and silver.	$9,13	$1.13	[a]$2.27	$6.16	− $2.47
Average value per ton of all metals	9.13	5.18	23.01	8.48	− 3.73

[a] Silver alone.

The following table shows the number of mines in Washington, by counties, according to their chief product in 1907, and also the number of nonproducing mines by counties:

Number of mines classified by chief product in Washington in 1907, by counties.

County.	Nonproducing mines.	Mines reporting production.	Gold placer mines.				Deep mines.				
			Hydraulic.	Drift.	Sluice.	Total.	Gold.	Silver.	Copper.	Lead.	Total.
Asotin	5										
Chelan	59	4					4				4
Clark	3										
Cowlitz	1										
Ferry	54	5					1	3	1		5
Franklin	1										
King	28	2					2				2
Kittitas	40	10	2	2	3	7	3				3
Lewis	1										
Lincoln	2										
Okanogan	98	9	1			1	4	2	2		8
Skagit	1										
Skamania	5										
Snohomish	49	4			1	1	1		2		3
Stevens	76	12					5	3	2	2	12
Whatcom	42	7	1		4	5	2				2
Whitman	1										
Yakima	3										
Total	469	53	4	2	8	14	22	8	7	2	39

REVIEW BY INDIVIDUAL COUNTIES.

ASOTIN, CHELAN, CLARK, AND FRANKLIN COUNTIES.

In Asotin, Clark, and Franklin counties together there were 9 nonproducing mines reported in 1907, and in Chelan 4 producers and 59 nonproducers. Chelan has no placers, copper, or lead mines, all its 4 producing properties being quartz mines, which had a yield of $2,766 gold and $35 silver, or a total of $2,801, and even this was an an increase over the year 1906. The Rico Consolidated mine and its 20-stamp mill at Blewett, which were idle in 1906, continued so in 1908, but will probably be operated in 1908. The Golden Eagle, with 6 stamps, at Blewett, is also expected to produce in 1908. The Blewett district made a small production, most of the yield, however, coming from the Entiat district. The Rex Group at Entiat had 20 stamps working. Lakeside district reported considerable active development for 1907, and the Leavenworth district will probably produce in 1908.

FERRY COUNTY.

The reports from 5 producers in this county in 1907, as compared with 10 producers in 1906, showed the decided falling off of $66,710 in gold and $8,278 in silver, a total of $74,988. Reports showed 54 nonproducing mines in the county. The producing mines are in the districts of Meteor, Danville, and Republic. The mines at Danville yielded the most gold, silver, and copper, the copper values predominating. The Republic district, from which much had been expected, made a poor showing, reports giving only 195 tons of ore worked, yielding $8,825, of which $7,325 were in silver values.

Many of the old companies have gone out of existence, and only a few mines are being actively worked. Some new strikes have been made on the eastern belt, and new companies will be formed to work the properties. The output of the Republic district was $78,795 less in 1907 than in 1906. The present cost of freight and treatment of the ore in this district is too high for the general average grade of ore found. Some cheaper means of treating the ore will have to be devised before the district can be made to flourish. The Colville Mining and Smelting Company at Republic completed a Medbury rotary smelter in August, 1908. At Keller, the owners of the Keller smelter have bought the Manila mine, and will run both mine and smelter in 1908. The Byrne Mining and Smelting Company will also resume in 1908. The copper mines at Danville ship their ore to their own smelter at Greenwood, British Columbia, and the product is sold to the United States Metals Refining Company at Chrome, N. J.

KING AND KITTITAS COUNTIES.

In King County there were but 2 producers in 1907, while 28 non-producers reported. The 2 producers were both at Berlin, and made a total yield of $10,698, of which $10,345 was gold and $353 silver, all from siliceous ore. Since the close of the year the railroad has been completed to the Apex mine at Berlin.

Kittitas County had 10 mines reporting production and 40 reporting none. Of the producers 7 were placers and 3 were deep mines. The total output was $8,755, of which $8,686 was in gold. Of this total gold $6,803 came from placer mines and $1,883 from quartz mines, all in the Liberty (or Swauk) district. The producers were all small mines. There was a small decrease in the two counties for the year. At Clealum there are a number of mines, but none of them are producing, as it costs too much for transportation to the railroad. The Hellan Mining Company at Liberty has an amalgamation and concentration plant of a daily capacity of 40 tons, and the intention is to operate extensively in 1908 and treat a large tonnage of ore.

OKANOGAN COUNTY.

This county shows a small decrease in its output of 1907 as compared with 1906. Its product in 1907 was valued at $17,018, of which $9,394 was in gold, $2,384 in silver, and $5,240 in copper. There were 9 producing mines, all being deep mines except 1; and there were reports from 98 unproductive mines—the largest number in any county of the State. The producing properties are in the districts of Bodie, Chesaw, Methow, Nespelem, and Oroville, the most productive of these districts being Chesaw. The producers in the latter camp are the Butcher Boy, the Grant Consolidated Copper Company, and the Allen Placer Mining Company. This was formerly the Myers Creek district. The Butcher Boy became a shipper in a small way during the year to the extent of about 2 carloads a month. Recently the Olentongy Mining Company, owning 4 patented claims, has installed a hoist, compressor, etc., and will soon be shipping ore. The shipping station is on the Great Northern Railway, recently completed, and about 3½ miles from these properties. The Grand Consolidated Mining Company expended some $60,000 in development work in 1907, after having proved the value of the mine by test shipments. Since the close of the year the Molson Mining Company has built a new mill, which is now in operation. So much sulphide ore is being found that an effort will be made to install a smelter at this camp. This is the second year in which there has been copper production from this county. At Bodie the Bodie Transportation and Mining Company has a 10-stamp mill and cyanide plant. There are 5 claims in the group being worked by this company. At Methow the Hidden Treasure Mining Company on Squaw Creek made a small production from a 3-stamp mill, but did not start until December, 1907. At Nespelem the production is small, and as at other places, the operators are waiting for better transportation facilities. At Oroville there are 2 producing mines, both of which ship their ores to smelters at Tacoma and British Columbia. There was no yield from the mines at Conconully, as the owners are only doing development in a small way and waiting for transportation. The people there have some hopes of an electric railway shortly, and also of a local smelter. The Q. S. Gold Mining and Smelting Company is putting in an electric power plant and expects to produce in 1908 by smelting their ore. The property is in an advanced stage of development and can become a shipper as soon as transportation is available. The nearest point is now 22 miles away, but the survey for a new road passes near the property. While the road is being built the mine will be developed in depth.

SNOHOMISH COUNTY.

This county had a yield for the year 1907 from 4 mines of $73,268, of which $45,504 was in gold, $12,797 in silver, and $14,967 in copper. The increase over 1906 in gold was $42,631, and in silver $9,391. The copper output decreased in value $11,725, as several copper mines worked in 1906 were not operated in 1907. There are now 2 producing copper mines, the Wayside at Granite Falls and the Sunset Copper Company at Index. The largest producer of gold and silver in the county is the Monte Cristo Metals Company at Monte Cristo. At Sultan the mines are small placers. Neither the Bunker Hill nor Ethel Consolidated at Index made any output in 1907. The Bunker Hill has now a 100-ton concentrator for chalcopyrite ores, and one 50-ton reverberatory furnace with accessories. The company expects to do some custom work in the district. The smelter was blown in in July, 1908. Production was stopped while the smelting works were being erected in 1907. The Bonanza Mining and Smelting Company at Index was actively developed during the year. The New York-Seattle Copper Company at Index was under development and has a 100-ton concentrator, with crusher, rolls, jigs, and tables. Better transportation facilities are expected to put this company on a paying basis. The Smuggler Gold and Copper Company at Index did a good deal of development in 1907 and may ship in 1908.

STEVENS COUNTY.

Stevens County is still the most productive one in the State, its yield for 1907 having been $217,345, as compared with $148,849 in 1906, an increase of $68,496. The increased yield of gold was $71,751 and of silver $7,017. The copper values declined $947 and the lead $9,325. In 1907 there were 12 producing mines, and 76 mines that reported no production. There are no productive placers in the county, deep mines only having reported any yield. In this county are the districts of Bossburg, Chewelah, Deer Trail, Marcus, Pierre Lake, Northport, and Ryan. The most productive mine in total value in the county is the First Thought at Pierre Lake. Its values are all in gold and silver, and there are no reduction works at the mine, the ore being shipped to different smelters. Considerable development is going on at this point among other mines, and some new companies have been formed. At Bossburg the Old Bonanza, a silver-lead mine owned by the Deer Trail Consolidated Mining Company, is being actively developed and is producing. A new property at this place is the Robena Silver-Lead Mining Company, which has a concentrator and began shipping in 1908. The Old Dominion Mining and Milling Company at Colville, whose properties were idle in 1907, will reopen them during 1908. At Chewelah the United Copper Mining Company and the Jay Gould Mining Company made small shipments for test purposes in 1907. The Chewelah Copper Mining and Smelting Company is actively developing the Alberta mine. The Jolly Boy is being reopened in 1908 after a long period of idleness. The Independence Keystone Mining Company is developing its property, as is the Krug Gold Mining Company. In Deer Trail district there are 4 producers, the Deer Trail No. 2, the Providence Mining Company, the Royal mine, and the Tenderfoot mine. Of these the Deer Trail No. 2 yields considerable lead ore, which is shipped to the Everett Smelter. The Seal and Queen Consolidated Mining Company, which has a 10-stamp mill, has commenced producting since the close of 1907. There is plenty of ore of a fair grade reported in the camp, but transportation and treatment cost about $21 per ton, and it requires a good grade of ore to stand these costs. Some of the operators are in hopes of concentrating their ores, reducing the freight, costs, etc., and also of obviating the necessity of hand sorting and picking. At Marcus is the Napoleon group of the British Columbia Copper Company, which ships its ore to the smelter at Greenwood, British Columbia, the blister copper produced being sent to Chrome, N. J. At Northport are the mines of the Jupiter Lead Company, the ore from which is shipped to the Picher Lead Company at Joplin, Mo. No gold or silver is found with the lead. At Ryan there is only 1 small producer. Metaline district made no production in 1907, but is expected to show a large yield in 1908. The Mammoth Silver Lead Mining Company and the Morning Mining Company are together building in 1908 a 200-ton concentrating plant. The Spokane Lead Mines Company built a 50-ton concentrator early in 1908. The Lead King, the Larsen, and the Flusey mines will probably all be producers in 1908, and the Oriole will also probably ship that year.

WHATCOM COUNTY.

The total production of this county in 1907 was $28,920, of which $28,759 was in gold and $161 in silver. This shows a decrease of $9,437 in gold and $151 in silver, a total of $9,588. Whatcom is the principal placer mining county of the State, producing twice as much gold as Kittitas (the second placer county in rank) and two-thirds of the total Washington placer output. The placer yield of 1907 remained very nearly the same as in 1906, but the quartz properties of the county show a decided decrease. This was caused by the stoppage of all operations on the Mount Baker Mining Company's property in Mount Baker district, after the burning of their 15-stamp mill in July, 1907. The Bonito Gold Mining Company at Barron, in the Slate Creek district, worked a 10-stamp mill and cyanide plant during the year. This was the only productive quartz property in the county after the shut-down of the Mount Baker mine. The Minnesota Mining Company at Barron expects to run its 4-stamp mill in 1908. Considerable development work has been done on the John D. Rockefeller group of mines at the same place.

WHITMAN AND YAKIMA COUNTIES.

The Bald Mountain Mill and Mining Company at Oakdale, Whitman County, is a copper property upon which considerable development work was done in 1907. At the Elizabeth group, North Yakima, Yakima County, a smelter is being installed. The ore carries gold, silver, copper, and lead, but none was reduced in 1907.

WYOMING.

By Chester Naramore.

PRODUCTION.

During the calendar year 1907 the mines of Wyoming produced 452.02 fine ounces of gold, valued at $9,344; 3,715 fine ounces of silver, valued at $2,452, and 2,257,650 pounds of copper, valued at $451,530. This represents an increase of $2,823 in gold, 3,579 fine ounces of silver, and 2,233,650 pounds of copper, or a total gain in value of $452,082 over the output for 1906. In 1907 production was reported by 19 mines, of which 11 were deep mines and 8 were placers, as compared with 10 producing mines in 1906, of which 6 were deep and 4 were placer mines. The deep mines furnished 26,137 tons of ore, of which 66 tons were siliceous ores and the remainder would be classified as copper ore.

The siliceous ores decreased in quantity from 458 tons to 66, and in total value from $5,136 to $772, averaging $11.70 per ton in gold and silver values in 1907, as compared with $11.21 in 1906.

Copper ores bearing precious metals were the source of over 85 per cent of the gold produced by deep mines and of practically the entire silver output. The placer production amounted to $4,045 in gold and 74 fine ounces of silver, almost 3 times as much as in 1906.

Production of gold, silver, and copper in Wyoming in 1906 and 1907.

Metal.	1906.		1907.		Increase.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold ....fine ounces..	315.45	$6,521	452.02	$9,344	136.57	$2,823
Silver ....do....	136	91	3,715	2,452	3,579	2,361
Copper ....pounds..	24,000	4,632	2,257,650	451,530	2,233,650	446,898
Total........................	....	11,244	....	463,326	....	452,082

The increased gold production is due to the renewal of smelter operations at the Encampment smelter after an idleness of a year, and to the increased placer output in Crook, Fremont, and Uinta counties. especially in the last-named county. The larger silver and copper totals also result from the handling of greater quantities of copper ores, principally in Carbon County, and to a lesser extent in Uinta County.

Of very great permanent benefit to the mining industry of Wyoming was the building of railroads to or through isolated portions of the State. The Laramie, Hahn's Peak, and Pacific Railroad completed its road from Laramie to Centennial, and is building south into the North Park section of Colorado.

The Penn-Wyoming Copper Company has completed its railroad from Walcott, on the Union Pacific line, 44 miles south, to Saratoga and Encampment. Thus shipping facilities are furnished by these two roads to the mining sections of Albany and Carbon counties. In the central portion of the State, Natrona and Fremont counties are likewise benefited by the building of the Wyoming and Northwestern Railroad from Casper westerly through Shoshoni to Lander. The extension of the Burlington branch from Frannie (on the Cody branch) southward up the Big Horn River and across Big Horn County into the northeastern corner of Fremont County was also an aid to Wyoming's newest camps in the Copper Mountain section.

Source of gold and silver production in Wyoming in 1907.

	Number of mines.	Tonnage.	Gold.		Silver.		Total value.
			Quantity.	Value.	Quantity.	Value.	
Deep mines:		*Short tons.*	*Fine ounces.*		*Fine ounces.*		
Siliceous ore	11	66	37.25	$770	3	$2	$772
Copper ore		26,071	219.09	4,529	3,638	2,401	6,930
	....	26,137	256.34	5,299	3,641	2,403	7,702
Placer mines	8	....	195.68	4,045	74	49	4,094
Total	19	26,137	452.02	9,344	3,715	2,452	11,796

In classifying the 11 deep mines according to the chief product in 1907, we find 3 gold mines, 5 copper mines (2 of which produced a little gold and silver), 2 gold-silver-copper mines, and 1 silver-copper mine.

Production of gold, silver, and copper in Wyoming in 1907, by counties.

County.	Producing mines.	Tonnage.	Gold.		Silver.		Copper.		Total.
			Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
		Short tons.	*Fine ozs.*		*Fine ozs.*		*Pounds.*		
Albany and Carbon	5	25,998	232.29	$4,802	2,982	$1,968	2,230,415	$446,083	$452,853
Crook	3	....	29.03	600	9	6	....	....	606
Fremont	5	102	88.91	1,838	159	105	19,980	3,996	5,939
Johnson, Laramie, and Uinta	6	37	101.79	2,104	565	373	7,255	1,451	3,928
Total	19	26,137	452.02	9,344	3,715	2,452	2,257,650	451,530	463,326

REVIEW BY COUNTIES.

ALBANY AND CARBON COUNTIES.

Three mines in these 2 counties produced $62 in gold and 24,000 pounds of copper in 1906. In 1907, as the table shows, 5 mines in the 2 counties produced over half the gold, four-fifths of the silver, and practically all of the copper output of Wyoming, with a total value of $452,853—almost 98 per cent of the value of the total production of the State.

ALBANY COUNTY.

Mining in Albany County in 1907 was restricted almost wholly to development work, but some copper was produced in the Douglas Creek district, where most of the development work in the county was carried on.

The Rambler Copper and Platinum Company, at Holmes, has a 200-foot vertical shaft and about 3,500 feet of drifts and crosscuts. A great variety of copper minerals are found in this mine, and platinum has been found with the covellite ores. The ore is said to occur in a series of fissures in dioritic granite.

The Topeka Copper Company did 500 feet of development work in 1907 and placed some ore in sacks and in ore bins, but was awaiting the completion of the railroad before shipping. The workings include a 75-foot shaft and 3 tunnels, respectively 700, 360, and 240 feet in length. The Alamo May Copper Company, the Medicine Bows Mines Company, the North Fork Mining and Development Company, and the Utopia Mining Company were also developing their properties in this district. The Suffolk Placer Company did not commence dredging operations during 1907.

In the Jelm Mountain district the American Gold and Copper Mining Company, the Annie Mining Company, and the Wyoming Queen Mining Company reported developments.

Operations at the Strong mine, in Horse Creek district, northeast of Laramie, were interrupted by a fire in July, 1907, which destroyed the surface buildings. The underground workings include a 360-foot shaft and about 1,000 feet of drifts.

Some work was carried on in the La Plata district, west of Centennial, at the Washington mine, which is equipped with a two-stamp, plate-amalgamating and concentrating mill.

In the extreme northeastern corner of the county, in the Laramie Peak district, the Boston-Wyoming Copper Company, formerly the Esterbrook Mining Company, has a 335-foot double compartment vertical shaft on the vein. Pumping was started January 15, 1908, preparatory to doing extensive development work.

CARBON COUNTY.

The year 1907 was an eventful one in Carbon County, the leading mining county of the State. The Encampment district was finally afforded transportation facilities by the completion of the railroad from Walcott to Encampment. Thus the reduced freight on supplies for mines and smelter, as well as the lower cost of shipping ore out, made it possible to operate mines which heretofore could not be worked at a profit. The rebuilding of the smelter at Encampment, which was destroyed by fire, afforded a market for the ores of this section during a portion of the year. The Independence Mining Company, near Dillon, was erecting a McDonald patent sulphide smelting furnace, with a daily capacity of 60 tons. This company also plans to handle custom ores from near-by properties, including the Congo and Batchelder mines.

The Ferris-Haggerty mine is the principal producer and chief source of ore for the Penn-Wyoming Company's smelter, with which it is connected by means of a 16-mile aerial tramway, with a rated daily capacity of 984 tons. The ore is reported to be bornite and chalcopyrite, varying in grade from a 35 per cent shipping ore to a 6 per cent concentrating ore, with the latter predominating. The vein occurs between schist and quartzite, containing a series of ore bodies varying in size up to 35 feet in width by 225 feet in length. The Doane-Rambler mine has also been made a part of the holdings of the Penn-Wyoming Company, and is being opened up preparatory to shipping to the Encampment smelter, via a branch tramway to be connected with the long tramway of the company.

The Rocky Mountain Copper Company, operating the Batchelder mine, sold its ores to the Encampment smelter in 1907, and reported the driving of a 250-foot tunnel, which is expected to drain 900 feet of workings.

The Copper Bar Mining Company has a 779-foot inclined shaft, a 351-foot tunnel, and 6 levels on the vein, aggregating 855 feet, at its Charter Oak mine, 7 miles north of Encampment. The ores are oxidized in the upper workings and sulphide on the lower levels. Some shipments were made to Denver during 1907. The Mohawk Gold Mining Company, at Saratoga, has a 62-foot shaft and a 90-foot tunnel. Gold is the principal value in the ore. Development work by the Itmay Mining Company has placed a large tonnage on the dump. The present workings include a 312-foot shaft and 800-foot tunnel and 260 feet of drifting on the vein.

The Snake River Consolidated Mining Company, controlling the Pease holdings in the Three Forks section, near the Colorado state line, reported considerable development work on ores carrying gold, copper, and zinc values.

The following companies reported development during the year: The Azurite and Congo mining companies, at Dillon; the Standard

Copper Mining Company, at Encampment, and the What Cheer Copper Mining Company, at Riverside. A number of properties, inactive during 1907, plan to resume operations in 1908, including the Dill Copper and Gold Mining Company, at Rambler; the Elk Mountain Mining and Milling Company, 18 miles southeast of Walcott, and the Independence Mining Company, near Dillon. (This company reports that nickel occurs in commercial quantity in some of their ore.)

BIG HORN COUNTY.

No production was reported from the mines of Big Horn County in 1907. In the Wood River district, about Kirwin, in the south central portion of the county, the following companies reported development work, which is almost entirely accomplished by means of tunnels. The Galena Ridge Mining Company, the Gold Cliff Mining Company, the Gold Reef Mining and Milling Company, the Shoshone Development and Improvement Company, the Shoshone Mountain Mining Company, the Silent Mining Company, the Washakie Mining, Milling, and Smelting Company, and the Wyoming Mining and Milling Company.

CROOK COUNTY.

As in the two previous years, the output from Crook County in 1907 was derived from sluicing operations on 3 small placer mines in the Hurricane district, northeast of Sundance, which amounted to only $600 in gold and 9 fine ounces of silver—a decrease of $385 in gold from the year 1906. The Independence mine, in the same district, has been consolidated with other deep mines by the Roenna Mining Company of Tintôn, and prospecting and development work is being carried on.

FREMONT COUNTY.

In Fremont County, during 1907, 3 deep mines and 2 placers produced $1,838 in gold, 159 fine ounces of silver, and 19,980 pounds of copper, with a total value of $5,939, as against $5,474 in gold and 127 fine ounces of silver in 1906.

There was a decreased gold production in both the Copper Mountain district, in the northeastern part of the county, and in the South Pass district, in the south central portion of the county, but the former section began shipping copper ore during 1907. The Copper Mountain district is one of Wyoming's newest and most active mining sections, and was the center of considerable prospect and development work. The formation is reported as being generally granite, with ledges of schist carrying the ore and with veins and bodies of quartz heavily mineralized. The principal metal values are in gold and copper. Some of the ore is high grade.

At the Williams-Luman mine, at De Pass, some free gold ore is found, but most of the value of the 1907 product was in copper. "The ore is found in a crushed and fissured diorite, much altered and almost unrecognizable in spots, and at the surface shows about 50 or 60 feet wide."[a]

The mine is being developed by a crosscut tunnel which cuts the lode at a depth of 220 feet.

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[a] Beeler, Henry C., Ann. Rept. State Geologist, Wyoming, 1907.

The Wind River Mining and Milling Company, operating the Hale mine at Bird's Eye, has a 330-foot tunnel, and is equipped with a 3-stamp plate-amalgamating mill, which was in operation in 1907.

The Three M's Mining Company made some shipments of copper ore which was extracted in doing development work. The Black Diamond mine is also being developed. In addition to this, much prospecting is being carried on throughout the district.

In the South Pass district, placer operations were carried on at the Coin placer and on the property of the Miner's Delight mine. This is one of the oldest and best known gold-mining sections of Wyoming, having been the center of extensive placer workings in 1869. The completion of the railroad, in 1907, to Lander, 35 miles distant, brings increased possibilities to the lode mining of this section, and has led to the renewal of development work at the various mines, including the following: The Good Hope, the Lone Star, and the Ground Hog mines, at Atlantic City; the Burr mine, at Lewiston; and the Carissa mine, at South Pass City (operated by the Federal Gold Mining Company).

During 1907 prospect work was started in the Willow Creek district, 22 miles west of Thermopolis.

JOHNSON COUNTY.

The Kelly Creek Mining Company, operating the La Porte mine at Buffalo, made a small gold production during a test run in their 5-stamp mill in 1907. In the same section (the Bull Camp district), the Top Hand Mining Company was developing its property during 1907.

LARAMIE COUNTY.

The Emerald Mining Company, of Wheatland, made a shipment of copper ore of good grade to Denver, in 1907, from its mine in the Sturgeon Gulch region.

In the Rawhide Butte district, in the northern end of the county, prospecting and development work was carried on by the Copper Belt Mines Company at Lusk and the Green Hope Mining and Milling Company at Inez. Similar work was done by the Federal Coinage Mining and Milling Company at Grant and at the Vulcan mine at Frederick.

UINTA COUNTY.

Uinta County is listed in the tables with Johnson and Laramie counties in order to hide individual mine productions. Some silver-copper ore was shipped in 1907 from Cokeville, on the Oregon Short Line, close to the Idaho State line, and increased savings were reported for 3 placer mines on the Snake River, in the Jackson Hole district, the Buffalo placer, the Davis placer, and the Pine Bar placer.[a] The gravel is hydraulicked and concentrated on patent riffles and burlap-lined tables, in order to catch the gold, much of it being very fine and difficult to save by ordinary sluices.

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[a] Schultz, Alfred B. Gold developments in central Uinta County and at other points on the Snake River, Bull. U. S. Geol. Survey No. 315, pt. 1, 1907, p. 71.

SILVER, COPPER, LEAD, AND ZINC IN THE CENTRAL STATES IN 1907.

MINE PRODUCTION.

By L. C. Graton and C. E. Siebenthal.

INTRODUCTION.

The following is an account of the production of silver, copper, lead, and zinc in 1907 by the mines of the Central States, including Arkansas, Illinois, Iowa, Kansas, Kentucky, Michigan, Missouri, Oklahoma, and Wisconsin. The territory thus embraced lies in the great interior valley province of the United States, which extends from the Appalachian system to the Rocky Mountain front, excluding the Black Hills. Most of the mines are situated in the Paleozoic sedimentary rocks of this province, but the copper range of northern Michigan comprises lavas and intercalated sediments of pre-Cambrian age.

The statistics of production given in the following pages are based on reports made directly to the United States Geological Survey by the mines, and represent the quantity of metals recovered or paid for in the ore that was sold or treated during the year. These figures are in close agreement with those reported by the smelters and refineries, which represent the actual quantity of finished metal produced within the year, though not wholly from ore mined the same year.

Statistics of actual mine production were first collected for Michigan in 1906. In 1907 for the first time mine production reports were collected from the other Central States; an exact comparison with the production of 1906 can not therefore be instituted this year. The inauguration of a mine census among a large number of mines has consumed the greater share of the time available for this statistical work, and in consequence the review of those States whose production is presented for the first time are more condensed than their importance warrants and than is hoped will be the case for subsequent years.

It is to be noted that the method of marketing and recording the mine output in the lead and zinc regions of the Central States differs from that employed in other parts of the country. In most camps the miner receives pay for his ore on the basis of the assay content of metal at a certain price per unit. In the lead and zinc regions of the Central States, however, the compensation is per ton of concentrates.[a] In effect, however, this is equivalent to paying for the metal contained, inasmuch as the price per ton is based on a sliding scale determined by the assay content. The details of this method are given in the pages devoted to Missouri. The figures which are reported to the Survey by most producers are tonnage and assay content of concentrates sold and amount received in payment. The total metal produced may be calculated from the first two of these items. In some cases, however, no record of the assay content is received. In the Joplin region this is not a serious matter, since yearly average or composite assays of all the zinc concentrates of that region are available and afford very accurate results, as is shown under the heading Missouri. These composite results, as is shown as a basis for calculating the metal content in all but exceptional cases wherein the reported assay differed widely from the average, in which cases individual calculations have been made. Similar individual calculations have been made where possible, or where necessary, in case of galena and for the oxidized ores of lead and zinc.

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[a] In local usage, the ore as mined is called "dirt," and the concentrates are classed as "ore."

In the case of the zinc concentrates of Wisconsin there is room for improvement in the data used in the calculation of contained metal. Owing to the fact that marcasite, which is plentiful in many of the zinc mines of that State, is in some cases removed by electrostatic or magnetic separation, whereas in other cases it is left in the concentrates, there is a wide range in the zinc content of the concentrates. In the absence of assay reports from all the producers, it has been impossible to make individual calculations for every mine, and in some cases averages have been necessary. The reasonable agreement of the mine production with the smelter production, as shown in the general report on zinc in Mineral Resources for 1907, indicates, however, that the calculations have given results very nearly correct. It is hoped that the chances for error may be decidedly reduced in the future.

The cooperation of all who have furnished information for this report is gratefully acknowledged.

PRODUCTION.

SILVER.

The production of silver in the Central States in 1907 was 328,411 fine ounces, which, at the average price of 66 cents per fine ounce, had a value of $216,751. No silver ores are worked in the Central States, and the comparatively small quantity of silver that is produced is recovered incidentally to the production of other metals. The greater part of the output comes from the copper lodes of Michigan, but lead ores of southeast Missouri and the lead-zinc-fluorspar deposits of the Kentucky-Illinois field also carry silver, some of which is recovered from the lead concentrates.

COPPER.

Complete figures of the production of copper in the Central States in 1907 can not be given, owing to the fact that the output of Missouri can not be disclosed. Michigan is the only other copper producing State and contributes nearly the whole of the entire copper output of the Central States.

LEAD.

The production of lead by mines of the Central States in 1907 was 146,379 short tons, which, reckoned at the average price of the metal for the year, $106 per ton, or 5.3 cents per pound, amounted to $15,516,174. Missouri, as usual, leads the other Central States in the production of lead, and for the first time takes first place in the United States.

ZINC.

The production of zinc in the Central States in 1907, based on returns from the mines, was 156,027 short tons. The value of this output, computed at $118 per ton, or 5.9 cents per pound, the average price of the metal for the year, was $18,411,086. Missouri again leads the Central States, and the United States as well, in the production of zinc.

PRODUCTION BY STATES.

The total value of the production of silver, copper, lead, and zinc in the Central States in 1907 was $77,697,457.[a] The contribution of each State and each metal to this total is shown in the following table:

Production of silver, copper, lead, and zinc in the Central States in 1907.

State.	Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Pounds.*		*Short tons.*		*Short tons.*		
Arkansas					12	$1,272	474	$55,932	$57,204
Illinois	2,852	$1,882			830	87,980	737	86,966	176,828
Iowa					242	25,652	145	17,110	42,762
Kansas					2,555	270,830	17,772	2,097,096	2,367,926
Kentucky	103	68			34	3,604			3,672
Michigan	299,764	197,844	217,767,232	$43,553,446					43,751,290
Missouri	25,692	16,957			138,675	14,699,550	116,752	13,776,736	[b] 28,493,243
Oklahoma					532	56,392	1,657	195,526	251,918
Wisconsin					3,499	370,894	18,490	2,181,720	2,552,614
Total	328,411	216,751	[a] 217,767,232	[a] 43,553,446	146,379	15,516,174	156,027	18,411,086	[b] 77,697,457

[a] Not including value of copper production of Missouri.
[b] Not including copper production of Missouri.

ARKANSAS.

By C. E. SIEBENTHAL.

PRODUCTION.

The production of lead and zinc in Arkansas in 1907 is shown in the following table:

Production of lead and zinc in Arkansas in 1907, in short tons.[a]

District.	Ore.						Metal content.			
	Lead concentrates.		Zinc concentrates.				Lead.		Zinc.	
	Galena.		Sphalerite.		Silicate and carbonate.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
North Arkansas.....	15	$800	538	$15,233	663	$16,210	12	$1,272	474	$55,932

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses in case of zinc but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York.

NORTH ARKANSAS.

Lead and zinc deposits have been known in Arkansas for many years. Lead was noted by Schoolcraft in his travels in 1819, and has been mined in a desultory way since the settlement of the State. Present development dates from about 1899, when there was a great rush to the north Arkansas field. The mines are principally in Marion County and in the adjoining portions of Searcy, Newton, and Boone counties, though there are also numerous mines and prospects in Baxter, Izard, Sharp, Lawrence, and other counties to the east. Until recently the mines labored under the disadvantage of a long wagon haul to the railroad and of high freight rates. The completion of the White River branch of the St. Louis, Iron Mountain and Southern Railroad and of the St. Louis and North Arkansas Railroad, has put most of the producing mines within 10 miles of railway transportation. Land for mining purposes is ordinarily leased in 10-acre tracts at 10 per cent royalty. Wood is universally used for fuel at the mines. There were at the close of 1907 some twenty steam concentrating plants in the district. These are of the Joplin type, and average about 100 tons in daily capacity. Mining methods are similar to those in vogue in the Joplin region, except that owing to the rugged character of the country many deposits have been found outcropping on the hillside, and have been followed in by day levels. Shallow deposits are won by open pits. At present prospecting is done by means of the churn drill. The ores are galena, sphalerite, and smithsonite. The sphalerite is generally very high grade, the concentrates, when clean, ranging well above the price basis, 60 per cent metallic zinc content.

Grateful acknowledgment is made of assistance rendered by Prof. R. W. Willett and Messrs. John A. Bunch, Ed. A. Zimmerman, and A. W. Estes in the collection of the statistics of the lead and zinc production of north Arkansas.

Zinc district.—At the Coon Hollow mine, noted for its great quantities of highly zinciferous tallow clay, a shaft is being sunk to a new body of ore. The Madison mine, equipped with a 100-ton mill, produced considerable zinc carbonate ore before being tied up in litigation. The Almy and Gloria mines, equipped with a 150-ton mill, were not in operation during the year. The Black Bear Land and Mining Company, having explored a body of ore with satisfactory results, decided to erect a 150-ton mill and develop the property.

Dodd City district.—The Iola Cooperative Zinc and Lead Company, 4 miles west of Dodd City, has a 100-ton mill equipped with compressor and air drills. The mine is operated by means of day levels or tunnels, one of which is 300 feet in length. Development work was carried on during the year, and considerable sphalerite was raised.

The Susquehanna mine, with 2 shafts 75 and 90 feet in depth, is pursuing development work, driving a tunnel toward the main ore body. The 100-ton mill turned out a considerable quantity of sphalerite ore during the progress of the work.

The 50-ton mill of the New South Mining Company, operating the Beatty mine on Jimmy's Creek, 3 miles east of Dodd City, and the 200-ton mill of the Nakomis Zinc Mining Company, were in operation for a portion of the year. The New York Lead and Zinc Company, operating the Bear Hill mine, and the Pilot Rock Lead and Zinc Company were also producers.

Kingdon Springs district.—The Monkey Hill Mining Company completed a 100-ton plant late in the year, and in a test run made several tons of sphalerite concentrates, which are reported as assaying 64.5 per cent metallic zinc. The Onwatta mine, 4 miles northwest of Kingdon Springs, equipped with a 150-ton mill, and the Big Star mine were also in operation.

The Olympia Mining Company has a shaft 150 feet in depth, reported as showing zinc ore at 90 feet and 120 feet. Steam crusher and rolls and hand jigs were installed. The Yale Zinc Company, sinking a shaft on the Cleveland land, is reported to have ore at 60 feet, 90 feet, and 110 feet in depth. The Schell Mining Company is reported to have a shaft in ore at 90 feet.

Rush Creek district.—The Morning Star Mining Company was one of the largest producers in north Arkansas, though in operation but three months during 1907. Considerable ore from the adjoining Smuggler mine was also run over the Morning Star mill, which has a capacity of 50 tons. A larger modern mill will be erected during 1908. The mine is operated by day levels or tunnels. The ore is zinc carbonate near the surface, but changes to sphalerite farther in. A mass of smithsonite, zinc carbonate, weighing over 6 tons, was taken from this mine.

The Silver Hollow mine and mill of 100-ton capacity, under lease to J. J. Reinhardt, was operated for seven months in 1907. On the expiration of the lease in August, 1907, the mine was closed down pending the installation of a compressor and air drills. The Philadelphia mine was also a producer.

Maumee district.—The Maumee mine of the North Arkansas Mining and Investment Company has a new 100-ton mill with Wilfley tables. The mill was completed and operated but a short time before being closed down by the panic. The ore is zinc blende in blanket formation at a depth of 100 feet from the surface. A small mill was installed at the North Star mine and development work carried on. The Jack Pot mine has been leased by John J. Geghan, who will build a 100-ton concentrating plant.

Mount Hersey district.—The Hurricane Zinc Company operated the Big Hurricane mine for six months in 1907, being closed down during the latter part of the year on account of lack of water. The mill has a capacity of 50 tons. The ore is zinc carbonate, of which the mine has for six years been a large and steady producer. Lumps of zinc blende, incrusted with zinc carbonate, are found in the less weathered portions of the deposit. The ore is mined by the open-pit method.

The May Mining Company, operating the Belle of Wichita mine, 4 miles south of Mount Hersey, erected a mill in 1907 and produced a fair quantity of zinc blende concentrates. The Spier Mining Company, in sinking the shaft to a deeper deposit, struck ore at 140 feet. The mine is equipped with a good mill. At the old Granby mines, 8 miles south of Mount Hersey, a good deposit of zinc ore is reported.

Other districts.—In the Hall Mountain district, east of Yellville, the Reynolds Mining and Development Company erected a 100-ton concentrating plant. The mine consists of an open cut extending 180 feet into the mountain and a shaft reaching the ore body. The Yellville Drilling Association put down a hole 500 feet in depth for development purposes. The Missouri and Arkansas Mining Company took a lease on the Hill Fountain property east of Harrison, prospected it, erected a 100-ton mill, and began production at the close of 1907. At St. Joe, development work was carried on at the Ward and the Montreal prospects. The Lincoln Mining and Milling Company erected a 100-ton mill and is engaged in developing the New Era mines near Smithville, in Lawrence County. The Arbuckle Mining and Milling Company began the construction of a 200-ton mill in the same vicinity. Water power afforded by Strawberry River will drive the machinery. The ore occurs disseminated in dolomitic limestone.

SOUTHWEST ARKANSAS.

The occurrence of lead and zinc in southwest Arkansas is uniformly in true fissure veins which cut across the quartzitic sandstone and slates, and have a filling of quartz.

The Bellah mine, in Sevier County, 6½ miles west of Gilham, was worked to a depth of 160 feet. The vein carried galena and chalcopyrite in the upper portion, but zinc blende predominated in the lower portion. The mine has not been in operation for several years.

The Houseley Mining Company is prospecting near Point Cedar in Hot Springs County. A group of veins, each in the neighborhood of a foot wide, have been opened laterally for a distance of 100 feet, and a shaft has been sunk to a depth of 40 feet. The ore taken out is reported to assay about 65 to 75 per cent of lead, 6 to 10 per cent of zinc, 1 per cent of copper, and to carry from 1½ to 3 ounces of silver, and from 0.05 to 0.08 ounce of gold to the ton.

ILLINOIS.

By C. E. Siebenthal.

PRODUCTION.

The production of lead, zinc, and silver, in Illinois, in 1907, is shown in the following table:

Production of lead, zinc, and silver in Illinois, by districts, in 1907.[a]

	Ores.				Metal content.					
	Lead concentrates, galena.		Zinc concentrates, sphalerite.		Lead.		Zinc.		Silver.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*		*Fine ounces.*	
Northern Illinois:										
Galena district	528	$28,407	2,530	$37,738	393	$41,658	737	$86,966	....	....
Elizabeth district	92	5,200	....	....	68	7,208	....	....	....	....
Total	620	33,607	2,530	37,738	461	48,866	737	86,966	....	....
Southern Illinois	497	28,021	....	....	369	39,114	....	....	2,852	$1,882
State total	1,117	61,628	2,530	37,728	830	87,980	737	86,966	2,852	1,882

[a] In calculating the metal content of the ores from assays, allowance has been made for smelting losses in case of zinc but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York.

The lead and zinc deposits of Illinois fall into two distinct regions marked by different mineralogical association and structural environment. Those of southern Illinois belong to the Kentucky-Illinois fluorspar district, while those of northern Illinois belong to the upper Mississippi Valley region.

NORTHERN ILLINOIS.

The lead and zinc mines of northern Illinois are all in Jo Daviess County, the extreme northwest county of the State. The ores have the same structural relations as in the upper Mississippi district generally; that is, they occur disseminated through the limestone, or in openings in it, known as "crevices," "pitches," or "flats," depending on their attitude to the horizontal. These openings have in general an east and west trend, known as their range. The ore bodies are sometimes continuous for long distances along these ranges, which for that reason largely control the prospecting, both by shafts and by drilling. The ores are galena, sphalerite, and smithsonite, though the latter is much less common now than formerly, when the deposits worked were mostly shallow and above water level. The galena is practically nonargentiferous. Iron pyrites is very commonly associated with the ores, frequently in such quantity as to necessitate roasting and magnetic association.

Galena district.—This district includes the mines in the vicinity of Fever River, from the Mississippi River to the Wisconsin state line. Though one of the earliest localities to be mined in the Northwest, there are still several very productive mines.

The Appleton-Galena Lead and Zinc Company completed a 50-ton mill equipped with compressor and air drills, but after a test run, it was closed down on account of the business depression. The Marsden Black Jack Mining Company reopened the old mines at Peru, which were steady producers some years ago, and built a mill with a capacity of 100 tons. The Northwestern Lead and Zinc Company was in operation for six months during 1907, closing down on account of the panic. The mill has a capacity of 70 tons. The Pacific Gold Mining Company completed a 50-ton mill equipped with 2 Wilfley tables, but operations were stopped by the industrial depression before much ore was produced. The Ten Strike Mining Company, and the Illinois Lead and Zinc Company, each with a 50-ton mill, pursued development work during the year. The Vinegar Hill Zinc Mining Company, after a long campaign of prospecting, built a completely equipped 100-ton concentrating plant; and began production just at the close of the year.

Elizabeth district.—Several mines equipped with hand jigs raised and cleaned small quantities of lead; among them were the Kansas Lead Company, the Elizabeth Mining and Investment Company, the Wishon Mining Company, and the Illinois Mining Company. No zinc ore was produced, and the 100-ton mill of the Skene Lead Company was not in operation during the year.

California or Sand Prairie district.—The Royal Princess Mining Company completed a 100-ton mill, and ran a short time before the close of the year. The ore made was not sold. It is reported that a fine body of zinc ore has been developed in the mine, which is on the site of the old "California diggings," which yielded a great deal of lead before the civil war.

SOUTHERN ILLINOIS.

The lead and zinc deposits of southern Illinois are found in Pope and Hardin counties, and are the northern extension of the Kentucky-Illinois fluorspar district. The structural relations and the mineralogical association are in common with the western Kentucky deposits, and in striking contrast with those of northern Illinois. The ores occur in fissure veins, in association with jointing and faulting. Dikes and sheets of lamprophyre occur in the vicinity, but not in direct connection with the ore deposits. Galena is the most important metallic mineral. Formerly large bodies of galena were worked, but it is at present produced incidentally in the concentration of the fluorspar.

The galena of southern Illinois is notably argentiferous as compared with the rest of the Mississippi Valley ores, the silver content ranging up to 12 and 14 fine (troy) ounces per ton of lead concentrates, and averaging for the whole production of the year 5.85 fine ounces per ton of lead concentrates. Sphalerite or zinc blende is the next most important metallic mineral, but it occurs much less plentifully than galena. It is recovered as zinc middlings in the concentration of the fluorspar. The difficulty of making a clean separation of the zinc middlings has kept down the production of zinc. None was reported from southern Illinois in 1907. The principal vein minerals are fluorite, calcite, and barite.

The Fairview Fluor Spar and Lead Company operates on the Good Hope vein, which was first opened in 1862, the first actual mining in the district. At that time the lead only was saved, the fluorspar being thrown on the waste heap, from which it was afterwards taken and sold. The workings reach a depth of 210 feet, and are practically continuous northward to the Rosiclare shaft. For 1907 the production of lead, as reported by the company, was the largest in the district. The Rosiclare Lead and Fluorspar Company, operating the same vein or one very near it, has reached a depth of 300 feet. Galena and sphalerite do not occur so plentifully as in the preceding mine.

The Marion Fluorspar and Lead Company, operating the Stewart mine, about 4 miles west of Elizabethtown, commenced work during the year, and took out considerable fluorspar, but sold no lead. The Crystal Fluorspar Mining Company operates the Empire vein, 8 miles northwest of Elizabethtown. The ore is mined by an open cut on the vein and a shaft reaching a depth of 160 feet. The vein follows a fault, and the filling consists of brecciated limestone cemented by fluorspar and calcite with galena and sphalerite in places in considerable abundance. The Evansville Lead and Spar Company is working in the Lead Hills, 3 miles north of Cave-in-Rock. The mill has a capacity of 25 tons. The Cave-in-Rock Mining and Milling Company reports considerable production of lead in 1907. The Eureka Lead Company is prospecting in fissure vein in the Lead Hills, about 5 miles north of Cave-in-Rock. The shaft at 80 feet is reported to be in a good body of zinc and lead ore. A mill will be installed early in 1908.

IOWA.

By C. E. Siebenthal.

PRODUCTION.

The production of lead and zinc in Iowa in 1907 is shown in the following table:

Production of lead and zinc in Iowa in 1907, in sort tons.[a]

District.	Ore.				Metal content.			
	Lead concentrates.		Zinc concentrates.		Lead.		Zinc.	
	Galena.		Sphalerite.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Dubuque	304	$22,023	303	$8,577	242	$25,652	145	$17,110

[a] In calculating the metal content of the ore from assays, allowance has been made for smelting losses in the case of zinc but not in the case of lead. In comparing the value of ore and metal content, it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York. The zinc concentrates included above were mostly sold late in the year when ore was at a low price, considerably below the yearly average. The value of the metal content is thus unduly high in comparison.

The lead and zinc deposits of Iowa extend along the Mississippi River for nearly 80 miles in Dubuque, Clayton, and Allamakee counties. The Dubuque mines were in early days the most important source of lead in the United States, and later the mines, particularly those in the vicinity of Durango, yielded considerable quantities of zinc carbonate ore. Nearly all this earlier mining was done above water level, and only within the last few years has there been much attempt to mine below water level. The production for 1907, though small, is noteworthy, since it marks the transition from shallow to deeper mining. There were 14 producing mines, of which only 2 yielded zinc ore, the remainder producing small quantities of lead ore. But 2 of the producing mines are equipped with steam concentrating mills, both erected in 1907, though one of them, that of the Fitzpatrick Mining Company near Buena Vista, was not put in operation.

The Avenue Top Mining Company's shaft is on the hilltop in the western part of Dubuque, and the concentrating plant is on the river bottom in another part of the city. The mill has a capacity of 80 tons and is equipped with two 8-cell jigs. It was completed in October, 1907, and ran for nine weeks. Much of the concentrates was stored on account of the depressed price of ore.

The Pikes Peak region, just southwest of Dubuque, formerly yielded some mixed sulphide ore from just below the water level. The difficulty of separating galena, blende, and marcasite, combined with the low price of ore, put a stop to operation at that time, but during 1907 there was considerable prospecting done. On the Miller farm the Dubuque and Lake Superior Mining Company early in the year made a good strike of disseminated zinc ore from 97 to 130 feet in depth, and laid plans for a mill, which the panic temporarily postponed. From the upper openings on the land a good production of lead was reported. The New Era Mining Company raised a good quantity of lead ore from their mine just west of the city, and the Goosehorn opened up a good prospect of zinc ore in the southwestern part of the city. At Key West, a few miles south of Dubuque, the Key West Mining Company and Messrs. Neenan and Gribben reported a good production of lead ore.

KANSAS.

By C. E. SIEBENTHAL.

PRODUCTION.

The production of lead and zinc in Kansas in 1907 is shown in the following table:

Production of lead and zinc in Kansas in 1907 by districts in short tons.[a]

District.	Ores.								Metal content.			
	Lead concentrates.				Zinc concentrates.				Lead.		Zinc.	
	Galena.		Carbonate.		Sphalerite.		Carbonate and silicate.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Galena	3,138	$178,979	8	$303	23,498	$911,382	94	$489	2,511	$266,166	11,651	$1,374,818
Badger-Peacock	37	2,682	......	......	12,113	520,716	......	......	30	3,180	5,992	707,056
Playter	17	942	......	......	260	9,625	......	......	14	1,484	129	15,222
State total	3,192	182,603	8	303	35,871	1,444,723	94	489	2,555	270,830	17,772	2,097,096

[a] The production of a single mine at Lawton, Kans., has been included in the figures given above for Playter, in order not to disclose individual production. In calculating the metal content of the ores from assays, allowance has been made for smelting losses in case of zinc but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York.

The lead and zinc deposits of Kansas, so far as developed, are limited to the southeastern portion of the State in Cherokee County. They comprise the western extension of the ore deposits of the Joplin region, and display the general characteristics of that area, except that here typical sheet ground deposits have not been developed. The ores are galena and lead carbonate, sphalerite or zinc blende, and zinc carbonate and silicate. The galena is practically nonargentiferous, carrying but a small fraction of an ounce of silver to the ton of lead concentrates. The industrial depression very seriously affected production in this area. The most important developments during the year were the opening of deeper deposits in well-known tracts and the extension of the productive territory along the border of the Cherokee shale from Badger to the southwest.

GALENA DISTRICT.

The Old Times Lead and Zinc Company completed a 150-ton electrically driven concentrating plant in June. Mr. C. W. Squires, in February, acquired the complete ownership of the Eagle sludge mill, formerly operated by Squires & Moore. It is the largest and best equipped sludge mill in the entire Joplin region, and has a capacity of 500 tons. The New Century Mining Company erected a new concentrating plant at a cost of $20,000. It is equipped with 4 rougher jigs, 2 cleaner jigs, 1 sand jig, 2 sludge tables, and is driven by a 150-horsepower engine. The capacity is 300 tons.

Rains Brothers and others developed a good prospect in Happy Hollow, 2½ miles southeast of Galena, in new territory. The Hartford Mining Company, operating in Rich Hollow, 2 miles east of south of Galena, found good runs of ore at 175 and 250 feet in depth, and erected a new 300-ton mill. The Neal Robertson Mining Company moved a 100-ton mill to the site of its mine. The Latawanna Mining Company purchased the 40-acre tract immediately west of Galena, and north of Seventh street, from the Galena Lead and Zinc Company. Ricksecker Brothers reopened the North Empire tract, discovering new deposits by drilling, and moved a mill to the property. The Lockport Mining Company, operating the Hoy tract, was a consistent producer throughout the year. The Sparks, Moore & Henderson Mining Company, operating the Murphy land at Empire, developed a lower run of ore at 135 feet, and a lower run was discovered on the old Baker tract west of Galena. Deeper deposits were also discovered on the Bonanza tract, northwest of Galena, and on the Ohio Mining Company's land, east of Galena. Donahue & Co. and Gerster & Williams opened up deeper ore on the South Side Mining Company's land. There were in operation on this tract at the close of the year five 100-ton concentrating mills and 22 hand jigs.

BADGER-PEACOCK DISTRICT.

There was much activity on the Hubbard farm following the first strike by the Hubbard Mining Company. Every lot in the 80-acre tract was leased, and numerous shafts were sunk, which found ore at various levels from 40 to 100 feet. The Hubbard mill is the only concentrating plant on the tract, but it does a certain amount of custom business. Later in the year an exceptionally rich strike was made in a drill hole which showed ore from 40 feet to 77 feet. This was in another part of the farm and not on the 80-acre mining tract, but will probably open up the whole tract for mining purposes. At the close of the year 13 companies were operating and prospecting on the Hubbard farm. An eastern company has purchased the Shellhammer tract just south of the Hubbard farm and has begun to develop it.

At Peacock, on the east side of Spring River, there are 10 concentrating plants and a sludge mill, and another sludge mill was under construction at the close of the year. Production was much curtailed by the panic and by high water which flooded the mines in Spring River bottom. The Peacock Valley Mining Company completed an electrically driven mill of 125 tons capacity.

PLAYTER DISTRICT.

The first lease on the land being operated by the Kress Mining Company and the Newton Zinc Company has been taken over by the United Zinc Companies. A discovery of shallow ore was made at

Playter in August, 1907, which was operated by an open cut. The Newton Zinc Company, in sinking the west shaft, encountered a fine run of zinc ore. Lead was discovered in the bed of Shawnee Creek on the Raines farm, and a prospect shaft was commenced near by.

KENTUCKY.

By C. E. Siebenthal.

PRODUCTION.

The production of silver and lead in Kentucky in 1907 is shown in the following table:

Production of silver and lead in Kentucky in 1907.[a]

District.	Ore.		Metal content.			
	Lead concentrates.		Silver.		Lead.	
	Galena.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Fine ounces.*		*Short tons.*	
Western district	54	$2,850	103	$68	34	$3,60

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[a] In calculating the metal content of the ore from assays, no allowance has been made for loss of lead in smelting. In comparing the value of ore and metal content it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York.

The lead and zinc deposits of Kentucky are found in two areas, the central district and the western or fluorspar district.

CENTRAL DISTRICT.

The deposits of this district are in Mercer, Scott, Franklin, Owen, Henry, and adjoining counties. The ore, mostly lead, occurs in veins asociated with such gangue minerals as fluorite, barite, and calcite. In some instances the lead has been obtained incidental to the mining of these minerals. No production of lead from the district was reported in 1907.

In Owen county, the Ohio Lead Mining Company has at Gratz a good concentrating plant, and has mined some lead ore. Lead only has been recovered, the barite tailings going to the waste pile. The vein from 6 inches to 6 feet in width has been followed vertically to a depth of 325 feet, and laterally for 1,000 feet, work being carried on at 3 levels. Southward across the Kentucky River in Henry County, the Union Mining Company and the Lockport Lead Mining Company have worked on the same vein of barite and galena, here from 1 to 2 feet in width. According to report the same vein is traceable northward 7 miles to Twin Creek, where prospects have been opened.

Lead has also been mined from the Johnson vein in Scott County, and the Clark vein in Franklin County. The Mutual Mining Company has an extensive plant near Stamping Ground, in which these ores are smelted. The products are barium sulphate, sodium sulphide, and lead sulphate.

WESTERN DISTRICT.

The lead and zinc deposits of the western or fluorspar district of Kentucky are found chiefly in Caldwell, Crittenden, and Livingston counties, but continue northward across the Ohio River, forming the southern Illinois lead and zinc district, and also southward in occasional deposits into western Tennessee. The ores are galena, sphalerite, and smithsonite, and occur in association with such gangue minerals as fluorspar, barite, and calcite. The ores occur in veins, in breccias, and as metasomatic replacements, all within or adjacent to zones of faulting. Considerable quantities of both lead and zinc ores have been produced in the past, but, at the present time they are produced as by-products in the recovery and concentration of fluorspar, which is the principal economic mineral of the district.

Owing to the difficulty of separating sphalerite and fluorspar, due to their close agreement in specific gravity, there has been much experimentation with electrostatic machines and flotation process to find some better way than the ordinary hydraulic methods. The Sanders Ore Separating Company, in a small experimental plant at Marion, Ky., successfully separated zinc blende from fluorspar by employing the Sanders flotation process, which uses a bath of aluminum sulphate. The concentrates are first reduced to a very fine powder and then passed over tables which make a separation of the lead and the fluorspar, leaving the zinc in the form of tailings, which are then treated in the flotation tanks. Pending the experiments there was a lull in zinc mining which the industrial depression served to continue. The Marion Zinc Company has over 100 tons of zinc-carbonate ore in the bins at the plant at Lola, Ky., which is tied up by litigation. No shipments of zinc ores in 1907 were reported.

The lead which was mined in 1907 was reported by 3 companies. Fluorspar, containing more or less lead, was produced by 18 mines. The output of half the mines was taken by the Kentucky Fluorspar Company at Marion, Ky., which company reports the largest production of lead concentrates. This lead, incorporated as it was in the crude fluorspar, can not be properly accredited to the mines producing it. The Albany Investment Company also reports a production of lead.

From the lead concentrates shipped in 1907 there were recovered 103 fine ounces (troy) of silver, an average of 1.9 ounces to the ton of concentrates. The silver content ranges from a very small quantity to over 3 ounces per ton.

MICHIGAN.

By L. C. Graton.

PRODUCTION.

The value of the copper and silver product of the mines of Michigan amounted in 1907 to $43,751,290, according to accurate returns furnished by every producing company to the United States Geological

Survey. Compared with the corresponding value in 1906, which was $43,940,489, this is a decrease of $189,199. Copper contributed to this total $43,553,446, the value of 217,767,232 pounds produced by 21 companies; the 299,764 fine ounces of silver produced by 10 of these companies had a value of $197,844. The slight decrease in total value in 1907 from that of 1906 was the result of a falling off in copper production which was only partly offset by a distinct increase in the output of silver. The average prices[a] of both metals remained substantially the same as for 1906.

Owing to a falling off in copper content of the ore[b] treated, the average total value per ton decreased from $4.94 in 1906 to $4.42 in 1907. All the values for 1907, with the changes from 1906, are here given in tabular form:

Value of silver and copper product of Michigan mines in 1906 and 1907.

Year.	Silver.		Copper.		Combined silver and copper.	
	Total value.	Value per ton of ore.	Total value.	Value per ton of ore.	Total value.	Value per ton of ore.
1906	$148,889	$0.0167	$43,791,600	$4.92	$43,940,489	$4.94
1907	197,844	.0200	43,553,446	4.40	43,751,290	4.42
Increase (+) or decrease (−)	+48,955	+.0033	−238,154	−.52	−189,199	−.52

The entire output of the State comes from a single district, the Keweenaw Peninsula. The metals occur almost wholly in the native state, in lodes of great extent and, as a rule, of remarkable uniformity. The ores are divisible into two classes dependent on the character of the copper-bearing material; these are amygdaloid lodes and conglomerate lodes. All the ores are of low grade and require concentration.

During the year 1907, there were mined and milled 9,892,214 tons of ore, and the production stated above is the actual or estimated quantity of metal recovered from this ore. The tonnage shows a large increase over that of 1906, and is probably the largest tonnage mined in any State, the only possible exception being Missouri.

From these ores 341,578,292 pounds of concentrates were derived. By far the greater portion of these concentrates was the fine-grained "mineral" produced by the stamp mills; the remainder was the coarser "mass" copper and "barrel work" sorted out at the mines.

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[a] In 1906 the average price of copper was 19.3 cents per pound, as compared with 20.0 cents in 1907; of silver 67 cents per ounce in 1906 and 66 cents in 1907. The lack of dependence to be placed on such prices that are the average of daily New York quotations is pointed out in the case of copper in the section "Production of Copper in 1907."

[b] The term in common use in the Lake region to designate the ore carrying native copper is "rock," while curiously enough the expression "copper ore" is there applied to both copper ores and copper minerals, but only to such as hold the copper in combination with some other element or elements. As used in this report the word "ore" is given the established meaning: A natural occurrence of a mineral substance of such richness in one or more of the useful metals as to bring profitable extraction of the metal or metals within the range of reasonable possibility.

These concentrates yielded[a] on smelting 63.75 per cent copper. The yield of refined copper per ton of ore milled was 22 pounds, or 1.1 per cent, a decrease from 25.2 pounds, or 1.26 per cent, in 1906. In view of the significance of this decrease in grade and of the importance of any attempt to counteract the decrease by improved recovery, some details are given on a later page (under Calumet and Hecla mine) of a new plant of promising effectiveness designed to reduce the proportion of copper lost in the mill tailings.

Of the total quantity of silver produced, 2,714 ounces were recovered as "pickings" at the mills. The remainder, or 297,050 ounces, was contained in 40,588,362 pounds copper that was cast in anodes for electrolytic refining.

Based on the total tonnage milled, the silver production represents an average yield of only 0.03 ounce per ton of ore. In reality, however, the silver produced came from much less than the total ore tonnage milled, so that the average silver yield of that ore from which silver was actually recovered was several times the 0.03 ounce per ton stated above.

The following comparative table shows the production of metal, concentrates, and ore in Michigan during the last two years:

Production of silver, copper, concentrates, and ore in 1906 and 1907.

Year.	Silver.		Copper.			Concentrates.		Ore.
	Quantity.	Yield per ton of ore.	Quantity.	Yield per ton of ore.		Quantity.	Yield.	
	Fine oz.	*Ounces.*	*Pounds.*	*Lbs.*	*P. ct.*	*Pounds.*	*P. ct.*	*Tons.*
1906	222,222	0.025	224,572,310	25.2	1.26	325,205,470	69.05	8,904,127
1907	299,764	.030	217,767,232	22.0	1.10	341,578,292	63.75	9,892,214
Increase (+) or decrease (−)	+77,542	+.005	−6,805,078	−3.2	−.16	+16,372,822	−5.30	+988,087

Three counties in Michigan are embraced in the producing district and contribute to its output of copper and silver. In the following table the output of ore, resulting product of concentrates, and the metals derived on refining are given for each county. Comparisons of the output of each county during 1906 and 1907 are given on subsequent pages.

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[a] These concentrates are not uniform in copper content, but differ according both to the original character of the ore and to individual milling practice. In general the richness decreases with the size of the constituent grains. Wherever the richness of concentrates is referred to in the following pages, it is the average of the various grades or sizes produced that is indicated. The fact may also be recalled that in the Lake Superior district the richness of an ore is never measured by its copper content, as is the custom in most other mining districts, but by the quantity of copper that can be recovered from it, thus excluding the losses attendant upon milling and smelting. This recovery is usually stated in pounds of refined copper or "ingot" per ton of ore.

Production of silver and copper in Michigan for 1907, by counties.

County.	Silver.		Copper.			Concentrates.		Ore.
	Quantity.	Yield per ton of ore.	Quantity.	Yield per ton of ore.		Quantity.	Yield.	
	Fine oz.	*Ounces.*	*Pounds.*	*Lbs.*	*P. ct.*	*Pounds.*	*P. ct.*	*Tons.*
Houghton	297,296	0.037	191,954,611	23.6	1.18	305,619,887	62.8	8,120,981
Keweenaw	497	.0004	18,595,931	15.8	.79	25,163,445	73.9	1,176,247
Ontonagon	1,971	.003	7,216,690	12.1	.60	10,794,960	66.8	594,986
Total	299,764		217,767,232			341,578,292		9,892,214
Average		.030		22.0	1.10		63.75	

Of the total 1907 output, 2,659,220 tons, or 26.9 per cent, of the ore mined and milled, was from conglomerate lodes. This ore yielded 11,170 fine ounces of silver, or 3.7 per cent of the state total, and 90,164,514 pounds of copper, or 41.4 per cent of the state total. All the conglomerate ores are mined in Houghton County. In the table which follows the comparative importance of the conglomerate and amygdaloid ores is shown for the last two years. The most significant feature is the marked decrease in richness and in relative importance of the ores from the conglomerate lodes.

Production of ore and concentrates, and yield in silver and copper in Michigan in 1906 and 1907, by kinds of ore.

	1906.		1907.	
	Amygdaloid rock.	Conglomerate rock.	Amygdaloid rock.	Conglomerate rock.
Silver:				
Fine ounces	192,023	30,199	288,594	11,170
Per cent of total	86.4	13.6	96.3	3.7
Average yield per ton of ore, ounce	0.030	0.012	0.040	0.002
Copper:				
Pounds	122,741,636	101,830,674	127,602,718	90,164,514
Per cent of total	54.7	45.3	58.6	41.4
Average yield per ton of ore, pounds	19.3	40.0	17.7	33.9
Average yield, per cent	0.96	2.00	0.88	1.69
Concentrates:				
Pounds	176,018,360	149,187,110	185,486,312	156,091,980
Per cent of total	54.1	45.9	54.3	45.7
Average yield in copper, per cent	69.7	68.2	68.7	57.7
Ore:				
Tons	6,357,445	2,546,682	7,232,994	2,659,220
Per cent of total	71.4	28.6	73.1	26.9

Although many lodes are known in the district and a number of them were worked in 1907, about 87 per cent of the entire ore output for the year was derived from 5 great lodes—the Calumet conglomerate, and the Kearsarge, Baltic, Pewabic, and Osceola amygdaloid beds. Owing to the added fact that the combined output of these five lodes is nearly twice as rich as the average of all the other lodes that produced during the year, these 5 lodes furnished about 93 per cent of the entire copper production for the State. The copper and ore output, and the yield of the principal lodes, and comparison with the other lodes combined, are tabulated below for the year 1907. In order that statistics given confidentially may not be disclosed, the figures for the copper and ore output for each of the lodes are not exact and are not even necessarily the round-number equivalents of the actual figures, but the true relative importance of the various lodes is expressed practically as well as if the actual data were given. The richness of each lode, given in the column under yield, however, is based on the original accurate statistics, and the same is true for the two lines showing the total copper and ore output and the combined average yield of these 5 lodes, and of all other lodes.

Copper and ore output and yield of the principal Michigan lodes in 1907.

Lode.	Copper.	Ore.	Yield of ore.
	Pounds.	*Tons.*	*Pounds per ton.*
Calumet	87,500,000	2,400,000	36.7
Baltic	41,000,000	1,900,000	21.2
Kearsarge	40,500,000	2,350,000	17.4
Pewabic[a]	20,000,000	1,250,000	15.8
Osceola	13,500,000	750,000	17.9
Actual total and average	202,336,197	8,641,361	23.4
All other lodes	15,431,035	1,250,853	12.4

[a] Partly estimated.

REVIEW BY COUNTIES.

The following pages aim to present in outline the physical status of the various mines, the principal factors affecting their production for 1907, and the efforts made toward maintaining or increasing the present production in the future. In general only such features of geology, methods, and equipment are touched upon as have a direct and essential bearing on the capacity for production.

HOUGHTON COUNTY.

Of the entire production of the State in 1907 over 88 per cent of the copper and more than 99 per cent of the silver were turned out by the mines of Houghton County. This county occupies the middle and richest 40 miles of the 70-mile productive belt that constitutes the district. It contains 12 of the 21 mines that were productive in 1907, and all but one of the larger producers. Seven of the 10 mines that produced silver are within the county. With the exception of about 18,600,000 pounds of copper and about 1,175,000 tons of ore produced from the Kearsarge lode in Keweenaw County, the entire output of the 5 principal lodes of the district belongs to Houghton County. Other lodes that contributed to the output of the county include the Isle Royale, the Quincy West, and the Winona amygdaloids, and the Allouez conglomerate.

The total production of the county in 1906 and 1907 is given in the following table, which also shows the proportion and the average yield from conglomerate and amygdaloid ores:

Production of ore and concentrates and average yield in silver and copper in Houghton County, 1906–7, by kinds of ore.

	Amygdaloid rock.		Conglomerate rock.		Totals and averages.	
	1906.	1907.	1906.	1907.	1906.	1907.
Silver:						
Fine ounces	186,807	286,126	30,199	11,170	217,006	297,296
Per cent, county total	86.1	96.2	13.9	3.8	100.0	100.0
Average yield per ton of ore ounce	0.038	0.052	0.012	0.002	0.029	0.037
Copper:						
Pounds	99,743,935	101,790,097	101,830,674	90,164,514	201,574,609	191,954,611
Per cent, county total	49.5	53.0	50.5	47.0	100.0	100.0
Average yield per ton of ore pounds	20.4	18.6	40.0	33.9	27.1	23.6
Average yield...per cent	1.02	9.3	2.0	1.69	1.35	1.18
Concentrates:						
Pounds	143,034,914	151,527,907	149,187,110	156,091,980	292,222,024	305,619,887
Average yield, ...per cent	69.7	67.2	68.2	57.7	69.0	62.8
Ore:						
Tons	4,832,263	5,461,761	2,546,682	2,659,220	7,438,945	8,120,981
Per cent, county total	65.8	67.2	34.2	32.8	100.0	100.0

Developments during the year on the Kearsarge, Baltic, and Osceola lodes promise to fully maintain the county for many years in its present predominant position, in spite of the approaching exhaustion of its greatest lode—the Calumet conglomerate.

Calumet and Hecla.—The Calumet and Hecla mine, one of the largest copper producers of the world, operated in 1907 on the Calumet conglomerate and on the Osceola and Kearsarge amygdaloids. The conglomerate lode, which has been the chief source of the company's enormous past production, was worked during the year through 1 vertical shaft and 10 inclined shafts on the lode. These shafts open the lode, practically without break, for 1¾ miles along the strike, and the total extent of drifts, crosscuts, etc., is said to be upward of 200 miles. One of the inclines, No. 4, Calumet, is 8,100 feet long, with a winze 190 feet deeper, both measured on the slope, giving a total vertical depth of about 4,850 feet. The Red Jacket vertical shaft is 4,900 feet deep. These two shafts probably represent the extremes to which sinking for 1-stage hoisting must be carried on the conglomerate lode, for, with two exceptions, shafts of this or less depth allow development of the lode to the greatest depth covered by the company's property. One of these exceptions is the ground south of the Tamarack tract, but owing to the fact that the great pay shoot on which the mine is worked pitches northerly in the lode, the lower limit of profitable ground does not extend so deep there as it does farther north. These southern shafts are bottomed in poor ground, and the shafts and pillars are being drawn preparatory to abandonment. No. 10 and No. 12 Hecla shafts have already been abandoned; No. 11 Hecla had only enough pillars remaining to slightly outlast the operations of 1907; and Nos. 2 and 3 Hecla are expected to be worked out within three years. The other exception is the L-shaped 200-acre tract known as the "Five Forties," which projects northward from the main holdings of the company between the Tamarack land and the Tamarack Junior branch of the Osceola. At its northwestern corner this tract contains the Calumet lode at an estimated vertical depth of fully one mile. The favorable character of the ground at the southern end of this tract, and the results attained by the Tamarack company just to the west, indicated the probability that the lode would be productive throughout a large portion of it. The plan of development decided upon was the sinking of a blind slope or inclined winze into this ground parallel to the lode. It was started north from the fifty-seventh level, the level at which the Red Jacket shaft intersects the lode, and was driven with a pitch to the north, so that though the lode has a dip of about 38° the inclination of this slope is only 22°, and though hoisting must be done, the ore remains in the same cars from the time it is loaded in at the working face till it is dumped in the pockets at the Red Jacket shaft at the fifty-seventh level. This slope, which was begun in 1903, had been extended from the fifty-seventh to about the sixty-seventh level by the end of 1907.

Although the Calumet lode has increased in width from about 13 feet at the outcrop to about 20 feet in the deepest workings, it is unusually regular as Lake lodes run. Another feature which has aided in making its working so profitable is the fact that in such portions of the lode as contain workable ore, practically the whole of the lode carries pay values, so that little or no sorting is necessary. An enormous quantity of timber is required to keep the workings open, the amount used annually at present being about 30,000,000 feet. This quantity of the requisite size represents from 1,000 to 1,500 acres of timber land.

Of the main Calumet and Hecla tract underlain by this lode about 720 acres had been wholly mined out by the middle of 1905; 320 acres had been opened up for extraction; 320 acres additional were thought probably to carry copper in paying quantity; and about 600 acres were regarded as poor. In the latter part of 1907 the management estimated that there probably remained 20,000,000 to 25,000,000 tons of profitable ore, which, at the rate of production then in force, would last from ten to fifteen years.

The new ground opened during 1907 north of the Red Jacket shaft, principally in the Five Forties, was found to maintain a higher average than the deep workings on other parts of the lode, which had been disappointing. Notwithstanding this improvement in grade in an important portion of the company's ground, the average yield of the conglomerate lode continues to decrease from a former average of almost 5 per cent[a] until for the year ending April 30, 1908, it is stated to have been 39.68 pounds per ton, or just under 2 per cent. The average of all the ore treated since mining began on the lode is about 60 to 65 pounds per ton. It is hardly to be doubted, however, that the decline to the present grade has been brought about in part deliberately, on account of improvements in recovery and lowered costs of operations. Even at its present yield the Calumet conglomerate is decidedly the richest lode in the Lake district. It also carries a little silver, part of which is recovered.

In order somewhat to offset the decreased yield of the conglomerate lode, there has been an increase in the tonnage treated, so that whereas 1,464,697 tons were stamped in the year 1900, yielding 59.93

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[a] In 1873 the ore output was about 200,000 tons at the yield given above.

pounds per ton, or a total of about 87,779,291 pounds of copper, the tonnage of conglomerate rock stamped during the year ending April 30, 1908, was 1,894,176, which, at an average yield of 39.68 pounds, was equivalent to about 75,160,904 pounds of refined copper. At this rate of about 6,000 tons per working day, the hoisting equipment on the conglomerate lode was employed to about 80 or 85 per cent of its capacity.

Production from the Osceola lode in Calumet and Hecla ground began in the middle of 1904, with an average yield of 22 pounds per ton. By a steady growth in output the fiscal year 1907–8 showed 603,891 tons stamped (about 2,000 tons daily), yielding the equivalent of 11,145,220 pounds copper, or about 18.4 pounds per ton. This output was made by 5 inclined shafts, of which the deepest one, that nearest the Osceola property, was over 2,000 feet deep on the incline. A sixth shaft, toward the northern end of the property, and over 2 miles distant from the most southerly one, was begun during the year. The lode is irregular, averaging probably 30 to 35 feet wide, but only the 8 or 10 feet near the hanging wall carry payable quantities of copper. Up to the present no regular stoping has been done from this lode, such production as has been made having come from development, in the course of which the drifts are made unusually large (locally called "drift stopes") in order to furnish a truer average of the ground traversed. By the end of 1907 there were nearly 20 miles of openings on this lode and the bed had been developed for about half of its total length in Calumet and Hecla ground. According to statements of the management, about one-third of the ground so opened up will be mined at a profit, and it is evident that a large output could be made if desired. The plan of the management appears to be to draw on the Osceola lode only enough to offset the gradual decrease from the conglomerate. The lode carries an appreciable quantity of silver, a considerable portion of which is recovered by electrolysis.

Figures given out by the management show that for the calendar year 1905, when the Osceola lode was being vigorously developed and produced only about 1,500,000 pounds of copper, the total cost per ton of ore stamped up to the point of delivering the concentrates to the smelter was about $1.57. This amount, which includes development, construction, repairs, administration, and every expense except taxes, is made up as follows:

Cost per ton of ore stamped from Osceola lode, Calumet and Hecla mine, 1905.

Openings:	
Shafts Part of drifting	[a] $0.0819
Stoping:	
Drift stopes Part of drifting	[a] .8844
Repairing shafts	.0003
Hoisting	.1010
Rock house (one-half of which is construction)	.1336
Transporting ore to mill	.0844
Milling	.2631
All other costs	.0180
Total	1.5667

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[a] Included in these two items is a charge of $0.0471 for timbering.

This total cost should be materially reduced when regular stoping is begun and the ratio of production to development becomes that of a normal producing mine.

The Kearsarge lode, on which production in Calumet and Hecla property was begun in 1906, contributed but slightly in 1907 to the total output of the company. At the 2 inclined shafts nearest the Centennial property, which have a depth on the slope of about 1,000 feet, development was carried on during only the earlier part of the year, but at the southernmost shaft, which is somewhat shallower, work was pursued steadily. The Kearsarge lode averages about 10 feet in width in this company's property. Although a slight production has been made from this lode, the general manager of the company states that copper has nowhere been found in it sufficiently plentiful to be profitable. The general outlook is good, however, for opening a mine here which can be worked under a favorable copper market. The company estimates that the cost of working the Kearsarge lode will be about the same as that for the Osceola lode.

The question whether the Osceola and Kearsarge lodes can be successfully and profitably worked to the western boundary of the company's property, granting the occurence in them of normal values, is as yet too remote to demand much consideration; and it is not unlikely that before this question becomes pressing, if it ever does, more reliable data than now exist relative to the economic limit of depth will have already been supplied by some other company.

During the year the use of electric power supplied by the central station at Lake Linden was extended, and the changing of the railroad between mine and mill to standard gage, which will greatly increase the capacity of the line, was carried well along toward completion.

At the mills on Lake Linden, the last 5 stamp heads were remodeled, giving now 28 single expansion heads available, of which 23 are for conglomerate rock. With the other 5 heads crushing amygdaloid, the mill has a nominal capacity of about 10,000 tons daily, and is thus the largest concentrating mill in the world. About 80 per cent of this capacity is utilized at present. Some idea of the size of this plant and of the mining operations that supply it may be gained from the fact that during the last fiscal year of the company the total ore milled was about 2,500,000 tons, and that during the calendar year 1907 each of the great mining States—Nevada, South Dakota, Idaho, California, and Colorado—mined less ore than was mined and milled by the Calumet and Hecla Company;[a] in fact, Missouri, Montana, Arizona, and Utah, were the only States which mined more, and Missouri and Montana the only States which milled more than this single company. If the present growth in output of the more easily crushed amygdaloid ore is to be maintained and the 23 conglomerate heads gradually be altered for amygdaloid service, the capacity of the mill can by this means be practically doubled by the time the conglomerate lode is exhausted.

It is interesting to note that the method of elevating tailings for distribution recently adopted at the Mohawk and Wolverine mills is not to be followed at Lake Linden, but that a new sand wheel for raising both sand and water is to be installed.

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[a] This comparison is confined to ores of gold, silver, copper, lead, and zinc. Iron ore is not included.

Erection of the new regrinding plant or tailings recovery mill progressed satisfactorily, and it is expected that a section of the mill will go into commission during 1908. When completed it will consist of 48 Chilean mills and 136 Wilfley tables with the necessary complement of classifiers, settling tanks, etc. For the present it is to treat the coarser tailings as they come from the jigs and finisher tables, but it is so constructed as to admit of the re-treatment of the old sands from previous years. Crushing from three-quarters inch through a 20-mesh screen, with about 75 per cent of the product finer than 60-mesh, the mill will have a daily capacity of about 1,500 tons. The material to be treated is run in separate launders to a sand wheel, elevated upward of 40 feet, and diverted to each grinding machine. The pulp is thickened and after crushing, the product of 2 mills, about 60 tons, is classified and fed to five tables, whence the concentrates are pumped into loading bins and the tailings are rejected.

Owing to the difference in size and distribution of the copper particles and the hardness of the rock in the two kinds of lodes, it is not profitable to concentrate the conglomerate ore so close as the amygdaloid, with a consequence that the conglomerate mineral yields between 50 and 60 per cent refined copper, compared with about 70 per cent yield from the amygdaloid concentrates. A recent statement shows that the total mineral smelted for the year ending April 30, 1907, a large part of which was undoubtedly from conglomerate ore, yielded about 59.1 per cent refined copper.

At the two smelting plants of the company, from 60 to 70 per cent of the smelting capacity is utilized. Several of the furnaces at the Hubbel works on Lake Linden were rebuilt and increased capacity for storage of mill concentrates was secured early in the year. At the Buffalo, N. Y., plant, a beginning was made toward enlarging the electrolytic department to practically double its present capacity. Several conditions unite to necessitate this increased capacity for output of electrolyzed copper. Among these are: The increase in arsenic content of the copper from the lower and northern workings of the mine; the prospect of a large product of somewhat arsenical copper from the Kearsarge lode, not only from the Calumet and Hecla ground proper, but from the La Salle, Centennial, Allouez, Gratiot, and possibly some other properties; also the probability of treating arsenical Baltic lode copper from the Superior mine; the growing output from the Osceola lode, whose copper is sufficiently pure without electrolysis, but contains enough silver to make profitable the application of this process; and finally the relatively great increase in demand for copper of high conductivity. At the smelters of the company the efforts to maintain the uniformly high quality of its product are noticeable in many respects and extend even to retention of the old-fashioned and slow method of hand pouring of the castings.

Some figures of smelting costs have recently been given and enable a comparison to be made with other Lake smelters. The cost of smelting (i. e., furnace refining) mineral at the Hubbel plant, which treats somewhat over one-half the company's output, was $6.96 per ton of mineral for the year ending April 30, 1907. The high cost of production from conglomerate ore is again shown here, for inasmuch as this mineral was mostly from the conglomerate lode and yielded only about 59 per cent copper, the cost of smelting was 0.589 cent per pound of refined copper produced. With increasing production from amygdaloid ores and attendant raising in grade of the concentrates, the added cost of casting more copper and the advantage of re-treating less slag will tend to balance each other, and the cost per pound of refined copper will be correspondingly lowered. At the Buffalo plant, which is newer and enjoys somewhat lower cost of labor and supplies, the cost of furnace refining is a little lower than at Hubbel. The cost of electrolytic refining and casting of the cathodes at the Buffalo works for the year ending April 30, 1907, was $8.497 per ton, or 0.425 cent per pound of copper, of which slightly over half was chargeable to the electrolytic work proper. The total cost, however, is more than met by the value of silver recovered and the profits on custom refining.

Tamarack.—The Tamarack mine, which adjoins the main Calumet and Hecla property on the west, began operations in 1882 to explore the lower portions of the Calumet conglomerate, and later extended some of its workings to the Osceola lode. Both these lodes outcrop to the southeast of the company's property, and occur within its boundaries only at comparatively great depth. Vertical shafts and long crosscuts are therefore necessitated. Five of these shafts have been sunk, at the end of 1907, aggregating 22,557 feet in depth, and ranging from 3,409 feet (No. 1) to 5,253 feet (No. 3), the latter still holding the world's record for depth. No. 4 shaft is not at present used for production.

The fire that broke out in No. 2 shaft early in 1906 and extended to No. 1 shaft, rendering those shafts useless throughout that year, as well as causing suspension of No. 5 shaft for the first third of the year, finally subsided in 1907. By January, 1907, No. 2 shaft had been repaired and mining operations resumed; by August the fire had burned itself out through No. 1, and by the end of the year repairs to this shaft had advanced considerably.

Owing to the fact that No. 1 shaft, which had previously been the principal center of mining on the Osceola lode, was not in commission, a very small portion of the company's total output was derived from amygdaloid ore, this having come from 1,200 tons taken out in the progress of a little drifting on the Osceola from No. 2 shaft. The values encountered at this place have caused development to be continued, and more productive operations will be resumed on this lode in the ground tributary to No. 1 when that shaft is in working shape.

In 1906, owing in part to the idleness of the south end of the mine, including the amygdaloid workings, and in part to the improved grade of ore raised through No. 3 shaft, the yield per ton of rock stamped increased to 25.2 pounds from 21.1 pounds in 1905. In 1907, however, with No. 2 and No. 5 shafts in practically constant operation, the better grade of the ore taken from No. 3 ground was partly offset, and the yield of refined copper per ton of rock stamped fell to 20.8 pounds. The result of this fall in grade, combined with high cost of labor and supplies and unusual expenses on account of the fire, caused the cost of production per pound of refined copper, according to the company's annual report, to increase from 15.29 cents in 1906 to 16.66 cents in 1907. The low price of copper for the last three months of the year, therefore, made operations unprofitable, and in consequence production was curtailed as much as the maintenance of the mine and organization of the force would permit. The total tonnage for the year, however, shows a large increase over 1906, with a resulting gain of over 12 per cent in the total copper output.

Improvements under ground during the year include the building of numerous chutes to eliminate shoveling into the tram cars; extension of mechanical haulage so that now six levels are thus equipped; and preparations for diverting all the surface water from the vicinity of shafts Nos. 1, 2, and 5 to a sump near No. 1 shaft, from which it will be pumped to the surface. For the first time all the Tamarack shafts are connected underground, giving improved ventilation, one of the most effective preventives of fire. The mechanical haulage, by rope traction with air power, applied now to both crosscuts and drifts, with resulting increased capacity and lower tramming cost, has to some extent lessened the great problem which the Tamarack has of late years been facing—that of great expense, excessive time, and limited capacity attending the driving and use of increasingly long crosscuts to connect the shafts with the lode. Owing possibly to this temporary relief, the idea of developing the lower portions of the company's property by means of inclines following the lode and hoisting in two stages appears to have been dropped for the present. If mining is to be carried to depths much greater than those at present attained, however, some means of avoiding these long crosscuts would seem imperative.

Drifting on the thirty-ninth or lowest developed level of No. 5 shaft opened ground of medium grade. Ground west of and adjoining the "five forties" tract of the Calumet and Hecla Company, opened by No. 3 shaft, continues to be good, and the eighteenth, or bottom level, is especially encouraging.

The 2 stamp mills on Torch Lake now contain 2 compound heads each, and another one is soon to be added in No. 1 mill, thus completing the replacement of the 5 simple heads formerly contained in that mill. During the year the mills handled 532,400 tons of ore, including a few carloads from the Cliff branch, producing 17,071,730 pounds of mineral that yielded about 65 per cent copper on treatment at the Dollar Bay works of the Lake Superior Smelting Company.

Osceola.—The three branches of the Osceola Company that had been operated during the previous year were productive in 1907. The Tamarack Junior branch lying between the Centennial and the Calumet and Hecla "five forties," that had operated on the Calumet conglomerate but ceased mining in 1902, remained idle.

The old Osceola, lying south and southwest of the Calumet and Hecla property, confined its operations, as previously in recent years, to the Osceola amygdaloid lode. The two inclined shafts now in operation are toward the southern part of the property. No. 5 shaft was sunk 60 feet during the year to a depth on the slope of about 4,300 feet, and No. 6 shaft, which was not deepened, has an inclined depth of a little over 4,400 feet. The drifting done for the year was cut down to about 4,000 feet, and was confined to the 8 lowest levels of the mine. Large reserves of ore are opened for stoping; the average yield of that mined recently has been about 18 pounds per ton. The copper from this lode is probably as pure as any mined in the Lake district. It contains some silver, which, however, is allowed by this company to remain in the copper. During the last quarter of the year, when prices were low and copper stocks were accumulating, the output of ore from this branch was reduced from an average of about 23,000 tons monthly to less than 13,000 tons. Advantage of this reduction was taken to put No. 6 shaft in a good state of repair, and during that time No. 5 handled the output from this branch.

The Kearsarge branches, working on the lode of that name, continued in operation throughout the year. At the South Kearsarge, No. 1 shaft was sunk nearly 400 feet to a total inclined depth of almost 2,600 feet. No. 2 shaft was unchanged at a depth of about 1,800 feet on the incline. The new drifting, about equal in extent to that of the preceding year, continues in ground of good grade. At the North Kearsarge, where that important lode was first opened commercially, No. 3 shaft was in constant operation and was sunk 60 feet, giving an inclined depth of nearly 3,200 feet. No. 1 shaft, 3,850 feet deep on the incline, went into commission in June after the completion of extensive repairs necessitated by the fire of 1906. In the new work timber has been used but is protected against fire by a sprinkling system. At No. 4 shaft, begun in 1906, toward the north end of the property, rock was finally struck, and by the end of 1907 the shaft was 50 feet in the trap of the foot wall, at a total depth of 162 feet. The mineralization of the Kearsarge lode in North Kearsarge ground continues erratic, but the general results of drifting for the year, reduced considerably from last year, were fairly satisfactory. The rock from the Kearsarge branches averages a little lower than that from the Osceola. At both the Osceola and the North Kearsarge branches 7-ton skips were installed.

The decrease in average grade of the ore from all branches from a yield of 18.3 pounds in 1906 to 17.4 pounds in 1907, coupled with the cutting almost in half of the tonnage sent to the mill for the last three months of the year, caused a large falling off in output. At the mills on Torch Lake, the 7 compound heads treated 811,603 tons of Osceola Company's ore, in addition to the output of the Ahmeek mine, also 1,200 tons amygdaloid rock produced by the Tamarack which the mill of that company, designed for conglomerate rock, could not handle to so good advantage. The Osceola mineral maintained its high copper yield of about 76 per cent and was smelted at the Lake Superior Smelting Company's Dollar Bay works. The Osceola Company pays the smelting company $8.75 per ton of mineral treated. Owing to the high copper content of the mineral the cost of this refining is brought to 0.573 cent per pound of refined copper. This figure is for the year 1906.

Centennial.—The Centennial mine, lying north of the Calumet and Hecla and west of the South Kearsarge and Wolverine, confined its operations, as in recent preceding years, to the Kearsarge lode, though previous attempts of unsuccessful outcome had been made to develop the Calumet conglomerate and the Osceola amygdaloid which also underlie the company's property. A small tongue of land projecting from the main tract of the company covers a short section of the outcrop of the Kearsarge lode and has permitted the sinking of 2 inclined shafts that run parallel to the lode and diverge downward. The deepest was sunk during the year about 250 feet, making a total depth on the dip of about 3,350 feet. The other shaft by sinking and raising is now connected with the 3,000-foot level (inclined distance). As distinguished from 1906, attention was directed in 1907 especially toward development, and accordingly the amount of drifting was decidedly larger than for 1906; the tonnage, however, was also increased somewhat. On the other hand, the average yield per ton decreased still further to 11.86 pounds, but this was in part the result of discarding a smaller percentage of the rock mined than in 1906. The results for the last half year were slightly better than for the first, and the general outlook at the end of the year was improving, especially at the north part of the mine approaching the neighborhood of the continuation of the rich shoot in the Wolverine mine. The total output of refined copper was a little greater than for 1906. A little silver was recovered as pickings.

Of the mill at Grosse Pointe on Portage Lake, that was bought from the Arcadian Company in 1904, one-half was sold to the Allouez Company early in the year and thereafter the mill was operated by the two companies as the Lake Milling, Smelting, and Refining Company. The 3 single-expansion stamps were devoted to crushing the output of these two mines. Of Centennial rock 200,040 tons were crushed, and the resulting mineral treated at the Quincy smelter with a yield of about 66 per cent refined copper. The mill was enlarged to accommodate 3 additional heads of the compound type, of which 2 were purchased during the year.

Wolverine.—The Wolverine mine, located on the Kearsarge lode between the North Kearsarge and the South Kearsarge mines, is noted as the richest amygdaloid mine and as a producer of copper at the lowest cost per pound of any in the district. Two inclined shafts in active operation were, respectively, about 2,800 and 3,400 feet deep along the lode at the end of 1907. The shallower shaft (No. 4), which is sunk in the foot wall, was equipped during the year with a new hoist capable of operating to the boundary of the property, a depth of about 4,300 feet on the dip. Electric pumping is to be installed during 1908. The mine is among the few which has shown marked increase in richness in depth. In the early part of the last decade the average yield of refined copper per ton of ore stamped was 16 to 18 pounds. For the last few years, though the value of the lode varies from place to place, the average annual yield has remained about constant; for the year ending December 31, 1907, the yield was 27.22 pounds, as against 27.06 pounds for 1906. Sinking of over 400 feet and drifting of nearly 5,000 feet opened ground which is expected to maintain about this yield. The small decrease in copper output for the year was mainly the result of severe weather early in the year, which prevented the shipment of a normal tonnage from the mine.

At the mill on Traverse Bay 340,613 tons were stamped by the 2 heads, producing 12,074,810 pounds of concentrates that yielded on treatment at the Michigan smelter about 77 per cent refined copper. It is intended during 1908 to begin compounding the stamp heads and installing a tailings elevator similar to that at the Mohawk mill.

Franklin.—The Franklin property consists of two tracts: A quarter section, known as the Old Franklin, located on the Pewabic amygdaloid, practically surrounded by lands of the Quincy company, and a larger area lying to the northeast, between the newly acquired property of the Quincy and the Rhode Island. The latter tract, known as the Franklin Junior, has workings on both the Pewabic lode and the Albany and Boston or Allouez conglomerate. The Old

Franklin, opened by 2 shafts, of which the deepest is about 3,200 feet on the incline, has been largely worked out to the boundaries of the property, and in 1907 less than one-third of the total copper output was derived from this branch. The ore is richer than that in the Junior mine, however, and yielded for the year 17.54 pounds refined copper per ton of ore stamped. Some additional ground of good grade is known to exist in the lower part of the mine, and some of this was opened up during the year preparatory to stoping.

At the Junior branch 2 inclined shafts, sunk to about 1,700 and 2,400 feet deep, respectively, are operated in the conglomerate lode, and 1 about 1,900 feet deep is used to work the Pewabic amygdaloid. All 3 were sunk during the year, the total sinking having been about 400 feet. A large amount of drifting was also done, especially on the Allouez lode. Most of the stoping was done on this lode and some good ground was opened in the bottom level, but with increasing depth the lode is narrower and the average copper content lower, and operations on it have not been profitable. It is probable that the conglomerate lode to the extent already opened up will be stoped out, but that attention will be turned chiefly to the Pewabic lode, where good ground is being encountered and the lode is increasing in width in the lower workings. A crosscut from the 2,300-foot level of the deepest conglomerate shaft has disclosed good ground in the Pewabic lode at that depth. The low grade of the conglomerate rock brought the year's average yield at the Junior branch for both conglomerate and amygdaloid down to 10.16 pounds refined copper per ton of ore stamped. The average of both the Old Franklin and the Franklin Junior was 11.48 pounds, a falling off of about three-fourths of a pound from the yield of 1906. Notwithstanding, therefore, a small increase in the tonnage treated, the total copper output showed a slight decrease. At the mill at Grosse Pointe, the fifth head, which was completed late in 1906, was operated during 1907 and permitted necessary repairs to be made to one of the old heads. During the year there were crushed 383,290 tons of ore, and the resulting mineral, combined with a little heavy copper produced, yielded 51 per cent refined copper at the Quincy smelter.

Quincy.—The Quincy mine, situated just north of Portage Lake, derived its principal output, as in previous years, from the Pewabic amygdaloid, but a portion of the product was contributed by the West lode. Four deep inclined shafts are operated, and at the end of 1907 the deepest of these, measured along the slope, had attained a depth of about 5,600 feet. Some of the levels are equipped with electric haulage. A new shaft, known as the Pontiac, was begun during the year to open ground farther north than could be reached advantageously from the Mesnard shaft. By continuation of the precautions adopted in 1906, of either filling or blasting in the walls of exhausted stopes and of leaving larger pillars, trouble from caving and subsequent "air blasts" was largely eliminated, and it is expected by the pursuance of these policies to render the mine permanently stable. Development work, especially shaft sinking, was carried on to a greater extent than in 1906, opening ground of average value and making the ore reserves the greatest in the mine's history. The tonnage was also the largest ever mined, and the yield per ton was almost as high as for 1906. Features worthy of note are the marked increase in amount of mass copper for the year, after years of decrease in proportion of this product, and the gradual narrowing of the lodes worked. Over 1,000,000 tons were treated by the 8 stamps at the mills, producing a mineral of about 63 per cent yield, which, treated at the company's smelter, gave a total output for the year considerably in excess of that for 1906. Inasmuch as a portion of the Quincy copper is associated with noteworthy quantities of silver, a considerable fraction of the total smelter output was cast as anodes and refined electrolytically at the Calumet and Hecla Company's Black Rock plant.

Isle Royale.—The Isle Royale mine, situated south of Portage Lake, close to Houghton, continued to derive its output in 1907 from the Isle Royale or Arcadian amygdaloid lode, although several other lodes are known on the property, of which two were formerly productive to some extent, and another, the Baltic lode, is the scene of present prospecting. The Isle Royale lode is of good width, but the copper is not uniformly distributed through it. In the early mining of this property ground was encountered that would now be regarded as very rich, but of recent years the yield has been low. In 1907 the yield of refined copper decreased slightly to 15.2 pounds per ton of ore stamped. Like the copper of the Baltic lode, the Isle Royale copper is arsenical. In places, also, the lode carries notable quantities of silver; the copper from such portions is accordingly cast into anodes at the Dollar Bay smelter and subjected to electrolytic refining in the East, by which means the deleterious element is eliminated and the valuable one recovered.

In 1907 the main producing shaft, No. 2, was sunk 160 feet, giving a total inclined depth along the slope of about 2,400 feet. No. 6 shaft, recently sunk to a depth of 370 feet, farther southwest on the lode, also supplied rock to the mill during much of the year. In No. 2 shaft the ground continues about as before, bunchy and of rather low grade. In No. 6 shaft, as in 2 new shallow shafts between No. 2 and No. 6, very good ground has been struck. The exploratory shaft southeast of the Isle Royale lode, sunk in the hope of opening the Baltic lode, had reached a depth of over 800 feet, with over 550 feet of drifting and crosscutting, but up to the end of the year had not encountered copper-bearing ground. Diamond drilling was done on the newly acquired Hussey-Howe lands, which adjoin the Superior on the northeast, to locate the Baltic lode. Early in 1908 a copper-bearing core was raised and was thought to be from the Baltic lode.

During the latter part of 1907 the output of the company was reduced, and advantage was taken of this opportunity to make needed improvements and repairs at No. 6 shaft and at the stamp mill. One compound head was in operation, and the 2 simple heads are to be compounded. The ore stamped during the year amounted to 175,450 tons, from which were produced a 74 per cent mineral that was treated at the Lake Superior Smelting Company's Dollar Bay plant.

Baltic, Trimountain, and Champion.—These three adjoining mines, situated on the Baltic lode southwest of Houghton, are under the same management and form virtually a single mining unit. Considerable heavy copper of both mass and barrel sizes is present in the lode, and much of the copper in the stamp rock is coarser than in most other lodes. Narrow calcite veinlets and seams, carrying copper minerals, are encountered in the workings. They commonly cut across the lode, are broken down in stoping, and their copper minerals are saved in the mill concentrate. Chalcocite and bornite occur in the veins, but in many instances they contain copper arsenides, and partly as a result of this the copper from these three mines contains appreciable quantities of arsenic. In 1907 for the first time a considerable portion of the total product of these mines was cast into anodes and shipped East for electrolytic refining, which not only eliminated the arsenic but recovered a small quantity of silver that had previously remained with the copper.

The general steepening in dip of the lodes from northern Keweenaw County southwestward is well exemplified by the Baltic lode, which has a dip of 70° to 73° to the northwest. In respect to width also the Baltic lode differs from the other lodes of the district, with a range of 15 to 80 feet or over in stoping width; in the wider portions the copper has extended apparently beyond the limits of the Baltic amygdaloid bed. In the working of most lodes of the district, the general method has been to stope those portions that carry pay values, with subsequent discarding of a relatively small amount of low grade or waste, avoiding and leaving as pillars those portions of the lode whose content is too low to render extraction profitable. In the case of the Baltic lode, however, the width and variable richness of the mineralized ground preclude such a system of mining and make it practically necessary to break down the entire lode over large areas. From such a method two chief problems arise, the disposal of large quantities of waste and the keeping open of wide stopes. The economical solution of both problems, avoiding unnecessary hoisting and the excessive use of timber, was the one adopted by the Copper Range Company—that of underground sorting and leaving the discarded rock as filling in the stopes. By keeping chutes and drifts open by means of dry walling the amount of timber used is kept at a minimum. It is hardly to be expected that this method, which has long been in operation in the West, can be applied to narrower lodes with such a great measure of success as has been attained on the Baltic amygdaloid; but its introduction more or less modified to fit specific conditions in certain other mines is doubtless going to result in lowered costs.

Each of the three mines is opened by 4 steep inclined shafts in the lode, and each of the shafts was deepened during 1907, the total sinking at the 12 shafts having been 2,251 feet. Drifting at the three mines during the year amounted to 24,396 feet, and crosscutting to the extent of 2,346 feet. These figures indicate increased development, especially in sinking, over 1906, which is preparatory to the planned increase in capacity. Considerable work was done in carrying out the plan of having a central electric power plant for the three mines, to be situated on Portage Lake. An electric pump was placed in each of the mines and gave satisfaction.

At the Baltic mine the deepest shaft was over 1,500 feet deep at the end of 1907, and all new openings showed ore of good grade.

Electric tramming was installed on 2 levels during the year, a single locomotive being made to serve all 4 shafts on each level. The success that has attended this improvement will lead to its extension as soon as power can be secured. At the Baltic mill at Redridge on Lake Superior, work of enlarging the building was carried on, Deister tables were installed, and addition of 2 compound stamps to the 4 heads in operation was well on toward completion. Rock stamped during the year amounted to 761,288 tons, producing a mineral which, combined with the coarser copper, gave a yield of 70 per cent ingot. The average yield of refined copper per ton of rock stamped was 21.94 pounds, as compared with 22.15 pounds in 1906. The total year's output was considerably larger than ever before.

At the Trimountain mine, the deepest drifting was on the sixteenth level at a depth of over 1,500 feet. At this level the ground encountered was not up to the average, but most of the other development for the year was attended with satisfactory results. The yield per ton of ore stamped fell off slightly to 18.43 pounds refined copper. The 4 compound heads, at the mill at Beacon Hill, on Lake Superior, stamped 444,358 tons of rock from which the concentrate, combined with mass, yielded about 64 per cent refined copper.

Developments at the Champion, the richest of the three mines, were prosecuted to a maximum depth of about 1,400 feet and continued satisfactory. Drifting at the south end of the developed area was continued preparatory to the sinking of a fifth shaft to operate in that ground. The decline in yield of refined copper per ton of ore milled from 25.2 pounds in 1906 to 23.27 pounds in 1907 was partly due to the fact that the normal proportion of mass copper could not be shipped during the last half of the year owing to repairs at the shaft houses. At the mill located at Freda, on Lake Superior, the installation was practically completed of 2 compound stamps in place of the experimental graded-crushing plant in use the year before. The 4 old stamps handled 708,685 tons, giving a concentrate that, added to mass and barrel copper, yielded 66 per cent refined copper.

The copper from the Copper Range mines is smelted at the Michigan Smelting Company's plant on Portage Lake, near Houghton, the largest and newest smelter in the district.

Winona.—The Winona mine, situated near the western boundary of Houghton County, about 20 miles from Portage Lake, is the southernmost of the producing mines in the county. The Winona lode, which has long been known, is an amygdaloid and has been regarded by many as the same as the Baltic lode. If the new lode opened at the Lake mine to the southwest proves to be the Baltic, the Winona lode is too far west to be thus regarded. The large proportion of mass copper found in the early days of the mine has diminished, so that at present most of the copper is obtained by milling. An inclined shaft dipping at about 70° with the lode had been sunk to over 1,000 feet at the end of 1907. A newer shaft, toward the southern end of the property, where the best values seem to lie, had attained nearly 600 feet in inclined depth at the end of the year. Developments were in ground of about average richness.

Owing to the low price of copper, production was stopped on November 1, and only development and construction prosecuted for the remainder of the year. Prior to October, 1906, when regular shipments began, considerable stamp rock had been accumulated from previous development. In 1907 this stock pile furnished a portion of the 102,101 tons of rock that were crushed by the stamp head leased at the Adventure mill. The combined mass copper and mill concentrates yielded at the Quincy smelter about 57 per cent refined copper, an average per ton stamped of 12.59 pounds, as compared with 14.34 pounds in 1906.

Exploration and development.—In addition to the work of exploration, development, and expansion prosecuted by the regularly producing companies already referred to, important work of this nature was carried on both in undeveloped property and in mines formerly productive. The new La Salle Copper Company, owning a large tract between the Osceola and the Rhode Island properties, carried on active development of the Kearsarge amygdaloid. On the portion of the property formerly held by the Tecumseh Company, and where the Kearsarge lode was first opened south of Calumet and Hecla ground, a shaft on the lode had attained an inclined depth of over 1,300 feet by the close of the year, and drifting had disclosed well-mineralized ground that is commonly estimated to yield about 1 per cent refined copper when treated. Two new shafts started farther southwest on the Caldwell section of the property had reached the lode and shown conditions justifying their continuation and regarded as encouraging. Drill cores from holes in Caldwell ground crossing the Calumet and Osceola lodes showed no copper, but the relation of good ground in the Osceola mine to the northern boundary of the La Salle would indicate that copper might be found in the Osceola lode at the northern end of the property. Aside from mill runs, no production has yet been made, but the company should soon be able to maintain a steady output and is expected to develop into an important producer. The current assumption is that for a time at least the rock will be stamped at the mills of the Calumet and Hecla Company, which owns a controlling interest in the La Salle.

At the Rhode Island, just north of the Franklin Junior, additional drill holes cutting the Calumet, the Osceola, and the Kearsarge lodes did not disclose copper in quantities sufficient to warrant further development. Some copper-bearing ground was encountered on the bottom (1,272-foot) level on the Pewabic lode, at the Franklin Junior end of the property.

The Hancock property, southwest of the Quincy, and underlying the town of Hancock, was actively developed during the year. The old inclined shaft on the Hancock lode was deepened to about 1,200 feet on the incline, and a large new vertical shaft was 530 feet deep at the end of the year. Drifting was done mainly on a lode known as the West Branch, and yielded satisfactory results. On the lowest level the main lode also gives promise of productiveness. It is expected that stoping and regular production from the West Branch will be commenced in the near future.

At the Superior, northeast of the Baltic, the main inclined shaft sunk in the foot wall of the Baltic lode was about 700 feet deep at the end of the year. The lode continues unusually wide and the copper content is good. Considerable ore has accumulated during development, and with the amount of ground ready for stoping, production may be started before the close of 1908. It is probable that the rock will be stamped at the Atlantic mill.

Nothing was done during the year toward reclaiming the old Atlantic workings which had been abandoned in 1906 because of caving. On property of the company lying just north of the Baltic and west of the Superior, however, exploration was continued, and the shaft designed to open the Baltic lode was carried to an inclined depth of about 1,000 feet. The ground has been found very much broken, hardly comparable with that a short distance away in the Baltic territory, and the showing is not so good as had been expected at this depth. But some copper has been encountered and the general indications warrant continuation of the development and lend encouragement to the work.

Sinking was continued during the year on the Globe property just south of the Champion. By the end of the year the shaft had attained a depth of 550 feet, more than half the estimated distance to the point of intersection of the Baltic lode. The prospects of finding good values are bright.

At the Challenge mine, 5 miles southwest of the Champion, development was continued actively, several lodes being explored with such results as to justify continuation of the work.

Work at the Wyandot, just east of the Winona, was discontinued on the Winona lode early in the year, and preparations were made for exploring the ground through which the new lode of the Lake Company is thought to pass.

Preparations for putting the King Philip, which lies just south of the Winona, on a productive basis were continued during the year, and it is expected that production will begin from the Winona lode during 1908. The first inclined shaft had attained a depth of over 600 feet at the end of 1907, and a second shaft had been started.

Following the failure of the Copper Concentrating Company in 1906 to treat successfully the tailings that had been turned out during previous years from the Quincy mill, other experiments were conducted along this line, but up to the end of 1907 adequate machinery had not been obtained. An attempt is now being made to work these tailings by the Mason Manufacturing Company, of New York.

In the early part of the year especially, considerable exploratory work was done at other properties, but no results of particular importance have yet been obtained.

KEWEENAW COUNTY.

The mines of Keweenaw County furnished in 1907 over 8.5 per cent of the total copper production of the State, but only an inconsiderable quantity of silver. The county occupies the northern part of the Keweenaw peninsula and comprises the north end of the Copper Range. Although the seat of many of the earliest mines in the district there were in 1907 but four producing mines in the county. The entire production was from amygdaloid ore and was derived almost wholly from Kearsarge lode; the Arnold "ash-bed" supplied a little. The table which follows shows the metal and ore product and the average yield for the last two years:

Production of ore and concentrates and average yield in silver and copper in Keweenaw County, 1906–7.

Year.	Silver.		Copper.			Concentrates.		Ore.
	Quantity.	Yield per ton of ore.	Quantity.	Yield per ton of ore.		Quantity.	Yield per ton of ore.	
	Fine ounces	*Ounces.*	*Pounds.*	*Pounds.*	*Per ct.*	*Pounds.*	*Per ct.*	*Tons.*
1906	1,850	0.0019	15,916,659	16.5	0.82	22,300,075	71.4	963,903
1907	497	.0004	18,595,931	15.8	.79	25,163,445	73.9	1,176,247

Developments on the Kearsarge lode for some distance north of the present producers are progressing satisfactorily and promise in the near future to contribute to the county's output. Operations near the north end of the peninsula, which began in 1905 and continued as extensive exploration in 1906, also yielded some favorable results in 1907, but the general outcome has not as yet been that unqualified success that had been expected, and it can not at this time be stated with confidence that important production from northern Keweenaw County is assured.

Allouez.—The Allouez mine is bounded on the south by the Houghton County line, and adjoins the North Kearsarge branch of the Osceola. The first work done on the property years ago was on the Allouez or Albany and Boston conglomerate, the lode recently worked in the Franklin Junior mine, but after many years of effort this attempt was given up as a failure. More recently attention was turned to the Osceola amygdaloid, but on this, likewise, the results were not satisfactory. Finally, in 1903, sinking was begun to develop the Kearsarge lode, which underlies the company's property, but outcrops in North Kearsarge and Ahmeek ground. Profiting by the experience of the Tamarack, whose property, similarly situated with reference to the Calumet conglomerate, had been opened by deep vertical shafts, necessitating the driving and operation of long crosscuts, and finding it impracticable to secure a portion of the outcrop and sink inclined shafts with the lode, as had been done by the Centennial, the Allouez management hit on an expedient which has proved very successful. The shaft No. 1 was located as near to the outcrop as the company's ground would permit, and was started with a dip in the same direction as that of the lode, but at a much steeper angle, viz, about 80°. Just before the lode was reached, the dip of the shaft was gradually flattened to coincide with that of the lode, about 39°, and from there downward the shaft follows the lode. This shaft, which reached the lode at 1,480 feet, was sunk 270 feet during 1907, and has attained a total depth along the incline of nearly 2,300 feet. In operation it has given such satisfaction that No. 2 shaft, begun in 1906, is being sunk in the same way. The location of this new shaft was necessarily such that it will not reach the lode until a depth of almost 2,400 feet is reached; so that, though this opening, sinking at the rate of 100 feet per month, was nearly 1,100 feet deep at the end of the year, and though a crosscut from No. 1

will intersect the line of the new shaft at the 1,650-foot level and furnish two more points of attack, it can not be expected that No. 2 will intersect the lode much if any before the end of the year 1908. A considerable amount of drifting from No. 1 shaft was done during the year. The yield of refined copper per ton of ore stamped decreased still further in 1907 to 13.66 pounds per ton, as compared with 19.54 pounds in 1906, but the percentage of rock discarded was less in 1907, and somewhat better ground is being encountered in the lower levels from No. 1 shaft. The decrease in richness of the rock treated caused a reduction of the year's copper output in spite of increased tonnage stamped. During the year 214,720 tons of Allouez rock were handled at the mill of the Lake Milling, Smelting and Refining Company, at Grosse Pointe, producing a mineral that yielded about 63 per cent refined copper. A little silver is picked out from the lump copper. This mill is owned jointly by the Allouez and the Centennial companies, and is being enlarged, as stated in the paragraph relating to the Centennial mine. The passage of these two companies under Calumet and Hecla control settles the problem of smelting facilities, as the mineral of these companies will all be treated at the Calumet and Hecla plants at the expiration of contracts with the Quincy Company.

Ahmeek.—The Ahmeek mine, lying east and northeast of the Allouez, like all the other producers of present importance north of the Calumet and Hecla, relies for its output on the Kearsarge amygdaloid, which was opened on the property in 1903 after unsuccessful work in early years on the Kearsarge conglomerate. The outcrop of the Kearsarge amygdaloid is covered by only a small section of the company's property, allowing room for only two inclined shafts on the lode. The acreage underlain by the lode is large, however, and holds the lode for a long distance directly down the dip from the present Mohawk workings, and at a depth comparable to that at which the Allouez reached the lode. At the end of 1907 the 2 shafts had attained inclined depths of over 1,200 and 1,300 feet, respectively. Although the yield of rock stamped fell off a little from the 18.4 pounds per ton of 1906, the developments of 1907 were satisfactory and assured large reserves of good ground for stoping. A large part of the total tonnage for the year came from drift stopes. By maintaining the average monthly tonnage to the end of the year, thereby almost doubling the year's tonnage as compared with that for 1906, the copper output in 1907 was largely increased. The extensive surface equipment was practically completed during 1907. Its operation thus far indicates that it is especially efficient and satisfactory. It is generally expected that the output of this mine will continue to grow, and it is probable that a mill will be built in the near future. The ore was stamped during 1907 by the Osceola mill, and the total so treated was 320,733 tons. The resulting 75 per cent concentrates were smelted at the Dollar Bay works.

Mohawk.—The Mohawk mine, covering the Kearsarge lode outcrop for about a mile and a half, lies east of the Ahmeek, and is the northernmost important producer on the copper range. As was expected, the production for 1907 showed a material increase, placing the Mohawk as the largest producer on the Kearsarge lode. Five inclined shafts, ranging in depth from about 600 to about 1,600 feet, open the lode, the oldest and deepest workings being to the north.

All the shafts were deepened during the year an average of 125 feet each. About 2 miles of drifting was also done. By these developments the north end of the mine was shown to maintain its average richness and the middle part was found rather better than that previously explored. The low-grade strip of ground opened by No. 4 shaft persists, but extensive opening at the southernmost shaft gave satisfactory results. The cross veins carrying copper arsenides were not worked. For 1906 the refined copper yield per ton of ore stamped was 15.12 pounds, showing a constant decrease from the yield of the first year of production, 1902. In 1907, however, the yield per ton hoisted was slightly greater than that for 1906, and by a little closer sorting the yield per ton milled was brought to 15.77 pounds. As a result of this and of somewhat increased tonnage treated, the copper output showed a distinct gain.

The two remaining heads of the 4-stamp mill at Traverse Bay, Lake Superior, were compounded during the year, but only 3 heads were in operation. Work was completed on the novel conveyor for tailings, whereby the sands are separated from the wash water, elevated, and carried to the point of distribution by a belt conveyor. This has worked satisfactorily and resulted in a lowered cost for tailings disposal. The quantity of ore milled during the year, 640,777 tons, would have been considerably larger had it not been for crippling of transportation by the severe weather of the first two months of the year. The mineral produced yielded about 77 per cent refined copper. When the fourth stamp begins dropping, the output of this mine should advance considerably.

Arnold.—At the Arnold mine, located on the northern shore of the Keweenaw Peninsula about 10 miles northeast of the Mohawk, some exploratory work was done on the Arnold ash bed, which had received some development years ago. In the course of this recent work a small quantity of mass copper was taken out and was smelted at Portage Lake.

Exploration and development.—As in 1906, the attempt to extend into the northern end of the Keweenaw Peninsula the belt at present productive was made chiefly by the Keweenaw, the Calumet and Hecla, and the Tamarack companies. The Keweenaw Central Railroad was during the year sufficiently completed to permit through transportation from deep water to the heart of the newly developing region, and will be completed to Calumet, its southern terminus, in 1908. Development on the lands of the Keweenaw Copper Company was continued throughout the year. Attention was directed chiefly to the Mandan-Medora tract lying between Mosquito Lake and Lac La Belle. The flat inclined shaft on the Medora amygdaloid was extended to a total depth of over 1,000 feet and considerable drifting was done. The exposures are well mineralized, and though the lode is rather narrow a considerable tonnage has been blocked out for stoping. Shipments from the stock pile and from underground are expected to begin in 1908, and will probably go to the Phoenix 1-stamp mill, which was acquired during 1907 by the Keweenaw Company. Development at the company's Empire tract, 3 miles farther northeast, was suspended in the early part of the year.

The option on a majority of the stock of the Gratiot Company, whose property lies northeast of the Mohawk, was exercised by the Calumet and Hecla interests. The 2 shafts on the Kearsarge amygdaloid had attained depths of about 500 and 600 feet, respectively, and the ground explored carried a satisfactory percentage of copper. The mine is generally expected to be in shape for production in the near future.

At the property of the Frontenac, another subsidiary of the Calumet and Hecla Company, lying south of the Arnold, exploration by diamond drilling was continued but was not of conclusive nature. During the year the lands of the Dana Company, practically inclosed by the Frontenac, were acquired by the Calumet and Hecla Company.

Developments continued at the Manitou, also controlled by Calumet and Hecla. Results on the Montreal River lode, which had previously been very promising, proved disappointing, and work was stopped. The workings of the old Conglomerate or Delaware mine on the Allouez conglomerate were unwatered, and this lode and the underlying Medora amygdaloid were found to carry fair copper values. Diamond drilling was continued at other points.

At the Cliff branch of the Tamarack Company, situated southwest of the Phoenix, drifting was done on several flat-lying amygdaloids and from one of them a few carloads of ore were sent for a test to the Tamarack mill and found to yield a fair quantity of copper. While not sufficient to assure the future of this property, the developments to date are of encouraging nature.

Toward the end of the year some trenching was done on the Seneca property, north and west of the Mohawk and Gratiot, with the object of determining a site for a shaft on the Kearsarge lode, which underlies the property.

The property of the newly organized Ojibway Company comprises hitherto undeveloped or little developed lands lying north of the Seneca, and is likewise underlain by the Kearsarge lode. Drill cores carrying very good values in copper having been obtained from this lode, two shafts were begun toward the end of the year.

ONTONAGON COUNTY.

Ontonagon County mines in 1907 produced about 3.3 per cent of the State's copper output, and about 0.6 per cent of all the silver. This production was made by 5 mines, of which 2 produce silver in addition to copper. The county holds the southwestern end of the Copper Range as at present developed. The geology of the southern end of the range is not so well understood as it is in Houghton County. There are a number of more or less cupriferous lodes, but most appear to be less persistent than the more productive lodes to the northeast. A characteristic of the southern lodes is the generally erratic or bunchy distribution of the copper. Mass copper is especially common in these southern mines, although not nearly of so great relative importance as in the early days of mining in the district. The production in 1907 was derived wholly from amygdaloid lodes, which include the Knowlton, the Evergreen, the Butler, the Calico, the

Branch, and the Forest. The county's record in 1906 and 1907 is shown in the following table:

Production of ore and concentrates and average yield in silver and copper in Ontonagon County in 1906 and 1907.

	Silver.		Copper.			Concentrates.		Ore.
	Quantity.	Yield per ton of ore.	Quantity.	Yield per ton of ore.		Quantity.	Yield per ton of ore.	
	Fine ounces.	*Ounces.*	*Pounds.*	*Pounds.*	*Per ct.*	*Pounds.*	*Per ct.*	*Tons.*
1906	3.666	0.0067	7,081,042	14.1	0.70	10,683,371	66.3	501,279
1907	1,971	.003	7,216,690	12.1	.60	10,794,960	66.8	594,986

Mining in Ontonagon County has been attended up to the present by rather doubtful success, owing to the low and variable grade of the lodes. Much interest has therefore been aroused by the discovery of a lode near the Houghton County boundary on which the small amount of development it has received indicates that it may yield much better results than any lode now mined in the county. The possibility that this is the Baltic lode, although as yet unsettled, adds to the interest in this discovery. To a large extent the future of mining operations in the county appears to depend on the outcome of developments on this new lode.

Lake.—The Lake Copper Company's property, formerly the Belt mine, lies near the eastern boundary of Ontonagon County, about 7 miles southwest of the Winona. The old mine had produced a small quantity of copper over twenty years ago, but had long been idle. In 1906 prospecting was started by the present company. The Evergreen and the Knowlton lodes were identified, and during 1907 a small production of mass copper from the Knowlton lode was secured. In the middle of the year all other work was discontinued to center effort on a new lode that had already been located by diamond drilling. This lode, lying near the Eastern sandstone, is farther southeast than any of the lodes heretofore worked in Ontonagon County. It was opened by trenching and a shaft was begun. By the end of the year it had been shown that the lode was wide, 40 to 50 feet, and that fine and coarse copper were present in amounts found in few amygdaloid mines. Development since the end of 1907 has been continued and is equally gratifying. While certain and final correlation has not yet been established, the general belief is that this new lode is the southwestern continuation of the Baltic lode.

Adventure.—The Adventure mine lies a little to the southwest of the Lake Company's property. As in the preceding year, the Knowlton lode was the only one productive, though others are known in the property. The amount of opening work for the year was small, and the 2 inclined shafts remained at depths on the slope of about 1,200 and 700 feet, respectively. Operations at the latter were suspended in the early part of the year. A great deal of the work of the year was devoted to improvement in handling the ore, and as a consequence the total cost of mining and stamping per ton was much decreased. A notable part of the reduction was in tramming costs, brought about by improvement to the electric haulage on the tenth level, and by running some of the eighth and ninth level ore down through a chute to the tenth level for the long haul to the shaft. Increased efficiency was also obtained in stoping.

During the first half of the year the yield per ton had decreased from the already low figure of 11.4 pounds refined copper obtained in 1906 to 11 pounds mineral or 8.7 pounds refined copper. The mineral yield was increased to 14.4 pounds per ton by December. The year's average yield of refined copper per ton of rock stamped was lower than that of any other company in the district, and probably lower than was ever before returned to any copper mining company as the result of a full year's operation.

A little silver was recovered at the mine during the year. At times in the past certain silver-rich portions of the concentrates have been cast into anodes and electrolytically treated at the works at Black Rock, N. Y. In addition to treating the Winona rock, the 3-stamp mill at Edgemere, on Lake Superior, handled a slightly greater tonnage than for 1906, producing a 67 per cent mineral that was smelted at the plant of the Quincy company.

Three diamond drill holes were driven from the underground workings into the hanging wall of the mine. From one of these a 17-foot section of core was taken, containing considerable fine copper. Drilling was also done on the southeastern part of the company's ground, to locate the lode encountered in the Lake ground; at the end of the year this hole was 1,550 feet deep. Two other holes are to be sunk with the same object.

Mass.—The Mass mine, adjoining the Adventure on the southwest, is opened by 4 inclined shafts, of which the deepest had attained a depth of about 1,850 feet by the end of 1907. Among the lodes which cross the property, the Evergreen, the Knowlton, and the Butler amygdaloids were worked during the year. Most of the stoping was done on the last two, although ground of workable grade was opened on the Evergreen lode. Mass copper, which amounted to about 20 per cent of the mine's total metallic output, came principally from the Butler lode, but some was obtained from the other two. In 1907 the yield of refined copper decreased over 1 pound to 10.16 pounds per ton of rock stamped, or barely over 0.5 per cent, and in consequence, though the tonnage milled was greater, the copper production fell off slightly from that of 1906. The production was also reduced early in the year by a strike of three weeks' duration. At the 2-stamp mill, located on Keweenaw Bay, 204,599 tons were crushed, furnishing a concentrate which, combined with the mass, yielded 71 per cent refined copper. Some silver was also recovered as "pickings."

Diamond drilling was done during the year southwest of the Evergreen lode along the supposed projection of the new lode opened in the Lake company's ground. Some cores carrying copper were obtained, but the significance of these occurrences had not been learned at the end of the year.

Michigan.—The Michigan mine, lying a few miles southwest of the Mass, derives its product at present from two amygdaloids, the Calico and the Branch lodes, though other lodes have been worked previously. Two shafts, A and B, each nearly 1,800 feet deep, and a third, C, sunk in 1907 over 800 feet to an inclined depth of more than 1,600 feet, permit the working of the mine. This mine, which in the early days was famous for the number and size of its native copper masses, still produces a larger proportion of mass than any other mine. Of the total cupriferous material smelted, over one-third was mass. The Branch "vein," narrow, but one of the richest lodes in the copper country, is especially productive of mass copper. Developments prosecuted on this lode during 1907 showed some falling off in richness, both in mass and in fine copper. The bottom levels of A shaft on the Calico lode are not showing well. In C shaft, however, where the highest levels were not encouraging, very good ground has been opened in the lower half of the mine on the Calico lode, largely increasing the company's reserves. The lower levels of the old Rockland workings, comprised now in the Michigan company's holdings, were unwatered, but no ground of minable grade was found exposed in the old workings.

The average yield of refined copper fell from 20.4 pounds per ton, stamped in 1906, to 17.72 pounds in 1907, so that notwithstanding an increase in the tonnage milled, the copper product was a little less than for the preceding year. During 1907 there were treated at the Atlantic mill, at Redridge, 150,407 tons. The combined mineral and mass treated at the Michigan smelter yielded 67 per cent refined copper.

Work on the company's new 2-stamp mill on Keweenaw Bay was carried on during most of the year and good progress was made. When this is finished, even if only one stamp is operated, the daily ore output should be considerably increased.

Victoria.—The Victoria mine, which lies about 4 miles southwest of the Michigan, is the southernmost of the important producers of the copper district. Although the oldest mine opened in the district in historic times, recent production began only in the middle of 1906. The mine is opened on the Forest amygdaloid, and the old No. 2 shaft, recently unwatered, and through which present operations are conducted, is about 2,100 feet deep on the incline. Developments underground for the year were prosecuted largely in the hope of opening up some other copper-bearing lode, and in consequence the amount of crosscutting was relatively large. The year's yield of refined copper was 12.7 pounds per ton of ore milled, as compared with 13.94 pounds for 1906. The falling off was due mainly to scarcity of labor, which made it difficult at times to supply the mill to its capacity and resulted in less careful sorting of the rock than would otherwise have been practiced. Improvements to the stamp head made during the year permitted a marked increase in capacity. Owing to operations having been carried on during the entire year, and on an increasing scale, the ore milled for the year amounted to 95,035 tons as compared with 39,185 tons in 1906. The mineral and mass copper yielded about 58 per cent on refining. The hydraulic air compressor installed in 1906 continued to give very satisfactory service, furnishing power for practically all operations at an extremely low cost.

Exploratory and development work.—Aside from the work of the producing mines mentioned above, the work of prospecting and exploration in Ontonagon County was devoted chiefly to lands west and southwest of the area at present productive. The Copper Crown Company, which had been working for some time at the old Norwich mine, 7 miles southwest of the Victoria, and had already encountered some encouraging ground, took out during the year some mass copper, which was stored at the mine. The company was planning early in

1908 to begin the erection of a mill within a year. The work done under option by the Calumet and Hecla Company on the Nonesuch mine, about 20 miles west of the Victoria, had been generally expected to result in favorable outcome. Diamond drilling had been done, the mine unwatered, and some of the ore put through an experimental mill. The results, however, were disappointing; work was stopped early in the year; and the option was allowed to lapse. The Sibley lands, near the Nonesuch, also under option to the Calumet and Hecla Company, have not given encouraging returns from the work expended on them; but certain lands east of the Nonesuch, also under option to the same company, promise better.

The developments on the new lode opened by the Lake Copper Company are being watched with much interest by the owners of nearby property, but aside from the exploratory work done on the southeastern part of the recognized copper range by the Adventure, the Mass, and the Victoria companies, little had been done up to the end of the year.

MISSOURI.

By C. E. Siebenthal.

PRODUCTION.

The production of lead and zinc in Missouri in 1907 is shown in the following table:

Production of lead and zinc in Missouri in 1907, by districts, in short tons.[a]

District.	Ore.							
	Lead concentrates.				Zinc concentrates.			
	Galena.		Carbonate.		Sphalerite.		Silicate and carbonate.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Southwest Missouri:								
Alba-Neck City	129	$9,799			22,945	$1,052,883	28	$448
Ash Grove	159	7,780	20	$560	20	560	15	375
Aurora	291	19,573			9,019	330,641	4,168	70,237
Carl Junction	159	11,347			992	42,916		
Carthage	13	903			2,538	106,969		
Cave Springs	40	2,126			779	30,429		
Duenweg-Porto Rico	2,812	200,026	170	5,875	17,378	721,034	500	10,172
Granby	1,340	96,418	57	1,375	2,535	113,760	11,006	297,135
Joplin	7,004	477,081	24	684	60,139	2,537,771	216	3,671
Oronoga	584	38,981			10,601	468,014		
Sarcoxie-Reeds					1,970	76,072	36	720
Sherwood	131	7,929			1,268	45,016		
Spring City-Beef Branch	957	73,696	86	3,287	3,536	131,628	1,076	18,391
Springfield	346	25,417			882	39,127		
Spurgeon	608	38,594			1,939	82,407	514	9,462
Stotts City	8	560			1,062	47,860		
Webb City-Prosperity	22,206	1,610,028			82,496	3,287,105		
Wentworth	10	737			629	23,760	79	1,205
Zincite	68	4,497			1,519	67,013		
Central and southeast Missouri	156,663	7,910,398			100	3,500	1,095	15,330
State total	193,528	10,535,890	357	11,764	222,347	9,208,465	18,733	427,146

[a] The production of a single mine at Diamond has been included with the production of Granby to avoid disclosing individual production. In calculating the metal content of the ores from assays, allowance has been made for smelting losses in case of zinc, but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York.

Production of lead and zinc in Missouri in 1907, etc.—Continued.

District.	Metal content.			
	Lead.		Zinc.	
	Quantity.	Value.	Quantity.	Value.
Southwest Missouri:				
Alba-Neck City	101	$10,706	11,515	$1,358,770
Ash Grove	135	14,310	14	1,652
Aurora	228	24,168	5,690	671,420
Carl Junction	125	13,250	497	58,646
Carthage	10	1,060	1,273	150,214
Cave Springs	31	3,286	391	46,138
Duenweg-Porto Rico	2,290	242,740	8,855	1,044,890
Granby	1,079	114,374	4,353	513,654
Joplin	5,503	583,318	30,220	3,565,960
Oronoga	458	48,548	5,316	627,288
Sarcoxie-Reeds	....	....	998	117,764
Sherwood	103	10,918	636	75,048
Spring City–Beef Branch	793	84,058	2,075	244,850
Springfield	271	28,726	442	52,156
Spurgeon	477	50,562	1,116	131,688
Stotts City	6	636	533	62,894
Webb City–Prosperity	17,410	1,845,460	41,371	4,881,778
Wentworth	8	848	338	39,884
Zincite	53	5,618	762	89,916
Central and southeast Missouri	109,594	11,616,964	357	42,126
State total	138,675	14,699,550	116,752	13,776,736

The silver production in 1907 was 25,692 fine ounces, valued at $16,957; the copper production can not be disclosed.

The main lead and zinc-producing regions of Missouri are southwest Missouri, the greatest zinc-producing area in the United States, and southeast Missouri, or the disseminated lead district, which is the second lead district in the United States in point of production, the Coeur d'Alene region of Idaho holding the first rank. The central Missouri district has produced considerable ore in the past, but is operated sporadically, and in 1907 had so small a production that its output is included with that of southeastern Missouri. The silver and copper production of the State is limited to the southeastern district.

Much of the ore raised in the Western States is smelting ore; that is, it can be smelted directly without preliminary concentration. All but a very small portion of the ore from the Central States is of such tenor that it requires concentration. The only fair basis for comparison of the relative magnitude of mining operations in different States is that of tonnage of crude ore, or, as it is called in the Central States, "dirt." However, in those States it is only the larger companies which make any record of the crude ore raised. In the Joplin region the number of cans of ore hoisted is usually kept, and the approximate weight of the cans is generally known. Thus, each company knows, in a general way, about what percentage of concentrates the mine run is yielding. Knowing the total production of concentrates and the average yield of concentrates from crude ore, it is easy to arrive at an estimate of the crude ore raised in Missouri in 1907. Figuring the yield of lead concentrates from southeast Missouri ore at 6.5 per cent, we get 2,410,400 as the crude-ore tonnage. Taking the concentrate production of the Oronogo-Duenweg belt as that of sheet ground, and figuring the yield at 3 per cent of the crude ore, we get 4,558,223 short tons as the quantity of crude ore raised; figuring the yield of the disseminated ore of southwest Missouri at 4 per cent, we get 3,538,875 tons as the crude ore for that section, a total of 8,097,108 tons of crude ore raised in southwest Missouri, and a grand total for the State of 10,507,508 short tons. If the yield of concentrates from the disseminated ore of southwest Missouri be figured at 5 per cent instead of 4 per cent, it gives 2,831,100 tons of crude ore, making a state total of 9,799,773 tons. Iron ore being excluded, the greatest tonnage of ore raised by any other State in the country is that of crude copper ore raised by Michigan, which amounted to 8,904,127 tons in 1906, and to 9,892,214 tons in 1907. On this basis Missouri ranks either first or a close second in crude-ore production in the United States.

SOUTHWEST MISSOURI.

The southwest Missouri lead and zinc area includes the largest part of the Joplin region, the remaining portion lying in southeastern Kansas and in northeastern Oklahoma. The ore deposits are found in Jasper, Newton, Lawrence, Greene, and adjoining counties. In 1907 this area produced 90 per cent of the lead ore and 85 per cent of the zinc ore raised in the Joplin region.

The lead ores are galena and a small amount of lead carbonate, locally known as "dry bone;" the zinc ores are sphalerite, or zinc blende, or "jack;" zinc carbonate (smithsonite), and zinc silicate (calamine), both the latter called "silicate." The galena is practically nonargentiferous, containing but a small fraction of an ounce of silver to the ton of lead concentrates.

The production of lead and zinc concentrates in southwest Missouri for the first six months of 1907 broke all records for the district, showing an increase over the corresponding period for 1906 of more than 20,000 tons of zinc concentrates and 6,000 tons of lead concentrates, and an increase in total value of over $2,000,000. The depression of the latter part of the year was disastrous, especially for the sheet-ground mines, many of which were unable to continue operations even with reduced wages, thus reducing the output toward the end of the year by 30 per cent, and practically offsetting the increase made in the first six months. Some of the miners thrown out of work by the closing down of these mines began to mine on their own account, working in shallow ground districts, gouging around old workings, or working over old dumps. The weekly reports for the later months of the year thus show a decrease in production, but an increase in the number of producers.

The writer takes pleasure in acknowledging the cooperation of Prof. H. A. Buehler, the state geologist of Missouri, in securing the statistical mine data for southwest Missouri.

ORE PRODUCTION.

Mining and milling practice in the Joplin region is so well known through the numerous articles that have appeared in the mining press of the country that but few words are necessary here.

The type of mill erected in the district is carefully chosen to fit the needs of the particular kind of ore body to be exploited, and, being based on the evolutionary experience of nearly forty years, is in general wisely selected.

In early days of zinc mining in the district when only the richest runs and pockets of the "disseminated" deposits could be profitably worked, and the life of the individual mine was necessarily short, a very simple type of concentrating plant came into use. It was equipped with a rougher jig and a cleaner jig, and had a capacity of 80 to 100 tons of crude ore per ten-hour shift. When a deposit was worked out, the mill could be easily and cheaply moved to another deposit. When the increased price of concentrates made it possible to mine lower grade ore, and the life of the deposits was thereby lengthened, somewhat larger and more complete milling plants came into vogue. Sand jigs and concentrating tables were added to the equipment, and the capacity was raised to 150 or 200 or more tons per shift. Such mills, developed by the necessities of local conditions, came to be characterized throughout the lead and zinc regions of the Central States as the "Joplin type."

A further increase in the price of concentrates, and the development of large bodies of low grade "sheet-ground" deposits, insuring permanence and stability of operation and necessitating every refinement of concentration, has resulted in the modern "sheet-ground mill" with capacity from 350 to 1,000 tons of crude ore per ten-hour shift, driven by steam, natural gas, or electricity, with complete equipment of ore-saving devices and with attendant economies of power, operation, and concentration. It is difficult to see how further progress can be made unless it be through the adoption of some other process than hydraulic concentration.

COST OF ORE PRODUCTION.

In the small mills of older type working on the "pockety" deposits, the cost of mining and milling varied within wide limits, depending on the efficiency of the mill and the character of the ground, whether hard or soft, and whether rich or lean in ore. With the development of sheet-ground mining and the sheet-ground mill, ore is won from such ground under conditions as fixed as those of a manufacturing enterprise. The following interesting cost sheets of the Providence Mining and Milling Company are quoted from an article by D. T. Boardman.[a] The mill is located a mile northwest of Webb City and has a guaranteed capacity of 250 tons per 10 hours shift, but, as will be noted, it develops a capacity of nearer 400 tons per shift. It is driven by steam, generated with natural gas as fuel. Aside from crushers, rolls, and screens, the equipment consists of a rougher jig with 6 cells each 36 by 48 inches, a cleaner jig with 6 cells each 30 by 42 inches, and 2 concentrating tables.

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[a] Eng. and Min. Jour., November 9, 1907, pp. 877–88.

Daily report, Providence Mining and Milling Company, Joplin, Mo., February 22, 1907.

LABOR ACCOUNT.

Number and occupation of men.	Hours, total.	Rate per day.	Total cost.
Jigmen (2)	20	$3.75 3.50	$7.30
Crusher feeders (2)	20	2.50	5.00
Cullmen (4)	40	2.25	9.00
Engineers (2)	24	3.00	6.00
Firemen (1)	12	2.50	2.50
Hoistermen (3)	24	2.75	8.25
Blacksmith (1)	8	3.50	3.50
Blacksmith helper (1)	8	2.50	2.50
Pumpman (1)	12	2.75	2.75
Ground boss (1)			4.28
Machine men (9)	24 48	3.00 2.75	25.50
Machine helpers (9)	24 48	2.50 2.25	21.00
Shovelers (13)	780	.07	54.60
Powderman (1)	16	3.50 3.00	6.50
Trackman (1)	8	2.75	2.75
Brunomen (2)	16	2.25	4.50
Tub pushers (3)	24	2.00	6.00
Tub hookers (2)	16	3.50 3.00	6.50
Sludgemen [table] (2)	20	3.00 2.50	5.50
Superintendent (1)			4.11
Extra men (4)	40	2.25	9.00
Total			197.04

SUPPLIES AND MAINTENANCE.

Amount and substance.	Rate.	Total cost.
9 boxes powder	$4.50	$40.50
600 feet of fuse	.40	2.40
23,200 cubic feet of gas	.125	29.00
O. & M.		40.00
Liability insurance		5.91
Total supplies and maintenance		117.81
Labor		197.04
Total expense		314.85

ORE ACCOUNT.

Tubs dirt hoisted (upper)	434
Tubs dirt hoisted (lower)	346
Tons dirt hoisted	351
Per cent of ore in dirt	3.98
Cars of jack	23
Cars of lead ore	7
Pounds of jack	19,550
Pounds of sludge	1,440
Pounds of lead ore	7,000
Total value jack, at $41	$430.30
Total value lead ore, at $44	$308.00
Combined value	$738.30
Less royalty	$73.83
Net value of ore	$664.47
Expenses	$314.85
Profit	$349.62

SUMMARY OF THE DAILY REPORTS, WEEK ENDING FEBRUARY 23, 1907.

Tons dirt hoisted.	Jack produced.	Lead produced.	Pay roll.	Expense.	Expense and pay roll.	Gross value ore.	Net value ore.	Net earnings.
352. 8	16,740	8,000	$201. 32	$115. 07	$316. 39	$695. 17	$625. 65	$308. 26
Sunday, pumping and repairing.								
368. 0	16,740	8,000	200. 70	125. 05	325. 75	695. 17	525. 65	299. 91
398. 0	13,790	7,000	208. 89	120. 05	328. 94	590. 70	531. 63	202. 69
435. 0	22,000	10,000	207. 76	125. 13	332. 89	892. 64	803. 38	470. 49
374. 85	15,410	7,000	201. 00	123. 06	324. 06	623. 90	561. 51	237. 45
351. 0	20,990	7,000	197. 04	117. 81	314. 85	738. 30	664. 47	349. 62
2,279. 65	105,670	47,000	1,216. 71	726. 17	1,942. 88	4,235. 88	3,812. 30	1,868. 42
Sunday, pumping and repairing								52. 21
Net earnings of Providence mill for week								1,816. 21

Average tons milled and mined per day	379. 94
Average yield of mineral from dirt (per cent)	3. 355
Average cost of mining and milling per ton (cents)	85

ORE SELLING.

As was noted in the introduction to this chapter, the lead and zinc ores of the Central States when marketed locally are sold on a plan which differs somewhat from the methods in vogue in the Western and other States. Instead of getting pay directly for the metal contained in the ore as disclosed by the assay, the producer is paid by the ton of concentrates, all ores being sold in the form of concentrates. The price is arranged on a sliding scale, the foundation of which is the price paid for ores of a certain standard—i. e., the "basis." In each of the ores a "basis" is arbitrarily taken which represents as nearly as may be the average metallic content of clean concentrate. In sphalerite or zinc blende concentrate the basis is 60 per cent (theoretical composition, 67 per cent) of metallic zinc, by wet assay or analysis; in the oxidized zinc ores, the carbonate and the silicate, the basis is 40 per cent (theoretical, 52 and 54 per cent) metallic zinc; and in galena concentrates the basis is 80 per cent (theoretical, 87 per cent) metallic lead. The buyer will offer so much for 60 per cent zinc ore which becomes the "base price." If the assay shows the concentrates to vary from the basis, $1 is added to the base price for each per cent of zinc above 60, and $1 subtracted for each per cent less than 60. Deduction is made for moisture, all concentrates being sold on dry, or net, weight. Penalties are exacted for the presence of undesirable elements, as iron, bitumen, barite, fluorspar, etc. One dollar is deducted for each per cent of iron above 1 per cent. The first ore sold from the new Miami district was penalized 2 "per cent"—that is, $2 was arbitrarily deducted for the bitumen clinging to the concentrates. Fluorspar occurs in the zinc concentrates of western Kentucky and southern Illinois, but neither fluorite nor barite are found in quantity in the ores in the Joplin or Upper Mississippi Valley district. The practice of buying zinc blende concentrates on an assay basis became general in 1899, though it began in a small way a few years earlier. Formerly the ore was bought on "flat bid"—that is to say, the buyer made a visual inspection and mental estimate of the metallic contents, and then offered so much per ton for the particular concentrates in question. An expert buyer can estimate the metallic contents very closely. Galena concentrates are generally bought on flat bid, though buying on assay is increasing. Ore which is sold in lump, such as hand-picked galena, and lead carbonate, and carbonate and silicate of zinc, is very generally sold on flat bid.

ASSAYS.

Several of the assayers in the Joplin district make a practice of saving the remnants of samples analyzed through the year. At the close of the year the lot is thoroughly mixed and carefully sampled, from which sample an average or composite assay for the year is made. Two representative series of such composite assays are given below.

The first series, by W. W. Petraeus, of Joplin, gives the result of analyses of composite samples from the general district for the last eleven years. The analyses for 1897–1905, inclusive, were published in the Lead and Zinc News, vol. 9, January 15, 1906, p. 8. The analyses for 1906 and 1907 were kindly communicated by Mr. Petraeus. Iron was not taken into account until 1900. Some 400 scattering assays, made in 1895–96, are excluded from the table.

Composite assays of zinc blende from the Joplin region, 1897–1907.

Year.	Composite sample.	Percentage of zinc.	Percentage of iron.
	Lots.		
1897	600	56.64	....
1898	1,299	56.99	....
1899	3,715	56.67	....
1900	3,500	57.36	0.22
1901	3,683	57.53	2.02
1902	5,776	57.08	2.24
1903	6,014	57.30	2.00
1904	6,220	57.24	2.10
1905	4,628	57.97	1.84
1906	5,644	57.2	2.00
1907	6,813	56.8	1.93

W. W. PETRAEUS, *Analyst.*

The composite sample for 1905 also assayed: Lead, 1 per cent; copper, 0.001 per cent; cadmium, 0.198 per cent.

The next series of composite assays was communicated by Prof. W. George Waring, of Webb City. The original samples were of ores from the different camps of the district except where otherwise indicated. The methods used in making these assays have been published.[a]

Composite assays of zinc blende from the Joplin region, 1900–1908.

Year.	Composite sample.	Zinc.	Iron.	Lead.	Cadmium.	Copper.
	Lots.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1900	3,894	57.30	3.03	....	....	....
1901	5,172	56.00	3.30	....	....	....
1901	2,757	55.30	3.86	....	....	....
1901	[1] ±2,000	55.90	3.47	....	....	....
1902	2,270	57.08	2.65	0.904	0.337	0.050
1903	2,145	57.75	2.32	1.072	.338	.049
1904	[1] 3,800	58.26	2.23	.701	.304	.049
1904	[2] 2,691	58.46	1.97	.720	.430	.050
1904	1,984	58.95	2.10	....	....	....
1905	4,520	58.95	2.00	....	....	....
1906	4,638	58.40	2.20	....	....	....
1906	3,968	58.20	2.29	....	....	....
1907–8	±4,000	58.70	2.00	....	....	....

[1] Joplin. [2] Webb City.

W. GEORGE WARING, *Analyst.*

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[a] Waring, W. George. The volumetric determination of zinc, Jour. Am. Chem. Soc., vol. 26, No. 1, January, 1904.

The complete analysis of the composite sample of the 3,800 lots of concentrate from the Joplin district in 1904, sampled by C. V. Millar and analyzed by Waring, is as follows:

Analysis of composite sample of zinc blende from the Joplin region.

Zinc	58.26	Calcium carbonate	1.88
Cadmium	0.304	Magnesium carbonate	0.85
Lead	0.70	Barium sulphate	.82
Iron	2.23	Silica	3.95
Manganese	0.01		
Copper	0.049		99.773
Sulphur	30.72		

W. George Waring, *Analyst.*

Both series of composite assays show a slight but gradual increase in the zinc content of the concentrates from the beginning of the series to the present time. The second series indicates a similar decrease in the quantity of iron. Both these changes are doubtless to be attributed to the increased efficiency of mills and milling practice, particularly in the sheet-ground districts. The first series shows indications of a lowering of the grade of concentrates by the custom-mill product of the gougers and scrappers in the latter part of 1907.

CALCULATION OF METAL PRODUCTION.

As already noted in the introduction the metal production of the mines is calculated from reports of the tonnage and assay content of concentrates sold as furnished the Survey by the producers. It was further noted that in the Joplin region the foregoing composite assays were used when advisable. To give some idea of the value of the results obtained in figuring the metal contents of the lead and zinc by the method, the following comparison is made. The factor used herein to represent the zinc recovery from sphalerite concentrates in the Joplin region is 50.15 per cent, which is calculated from the average assay content of sphalerite concentrates for 1907, deducting the average smelter loss. If we take the actual zinc recovered from ores from the Joplin region and the total concentrates from which this zinc was recovered, both as reported to the Survey by the zinc smelters, and then deduct the carbonate and silicate concentrates from the one side and the spelter recovered from such carbonates and silicates from the other side, we find that the figure representing the actual recovery of zinc from sphalerite concentrates was 50.21 per cent, a difference from the assumed factor of only 0.06 of 1 per cent. This close agreement is due to the fact that the concentrate is a simple mineral with a single metal base and not subject to the wide range of variation exhibited by ores smelted in the crude state, or by concentrates of minerals with two or more metallic bases, the proportions of which may vary within the range of their substitution for each other.

Alba district.—The tract of the Reliance Mining Company No. 3, operated by three subleasing companies, had the largest production in the Alba district, and the Rochester Land and Leasing Company, subleasing to the Moss Mining Company and the Lelah Mining Company, had the next largest output. Another large production came from the East Alba Mining Company's tract, which has two concentrating plants of 100 and 150 tons capacity, respectively. Various other tracts or companies credited with a good production in 1907 are the Eclipse Land and Mining Company's tract, leased by three operators, each with a 100-ton mill; the H. B. H. lease, with an 80-ton mill; the Bowen lease of the Federated Mining and Milling Company, operated by the Little Dana and Isabel Mining companies; the Luke and Brown No. 3 Mining Company's tract, operated by four companies, each with a 100-ton mill; the Evansville mine, with a 200-ton mill on the Penn Zinc Company's tract; and the Red Fox Mining Company's tract, subleased by three companies operating 100-ton mills.

The Big Indian mill, with 250 tons capacity in 10 hours, was completed in March and made a good output of high-grade zinc blende by the close of the season. A large tailings mill was erected on the Luke and Brown tract. The O. K. Mining Company, operating the Haworth land, suffered a loss of $5,000 through the caving in of a drift, which entombed a portion of the mill and 60 tons of concentrates. Active drilling was in progress during the year in the vicinity of Preston, 4 miles northeast of Alba. The Decatur Mining Company is reported to have struck 18 feet of sheet-ground ore at a depth of 218 feet, and other discoveries are reported in that neighborhood and also east of Alba.

Aurora district.—The Black land was operated by Reynolds & Co., Hudson & Co., and others. The ores are shallow lead and silicate and carbonate, with some zinc blendes, of all of which a good output was reported. The Cleveland-Aurora Mining Company reported a good output of zinc blende concentrates from 2 mills. The Jones land, operated by Sebrun Brothers, the Missouri Hydraulic Mining Company, and others, is reported to have made a good output of zinc blende. The Boston-Aurora Zinc Company in drilling struck ore from 183 to 253 feet. Two shafts were started to this run. There are 2 mills in the tract, from which there was a fair output of zinc blende. Coleman Brothers operated their 200-ton mill steadily throughout the year, making a good output of high-grade zinc blende. Scott, Coleman & Co., with 2 shafts in ore at 220 and 260 feet, respectively, made a good production of zinc concentrates. The plant of the Federal Zinc and Lead Company was operated steadily until June, when it was burned. It was replaced in October by a 400-ton modern concentrating mill. The United Zinc Companies operated a 175-ton mill steadily through the year and made a good output of zinc blende, in addition to which there was raised by small lessees a considerable quantity of silicate and carbonate ore. Among the other producers were the Decatur Lead and Zinc Company, the Kentucky Mining Company, the Louisville Mining Company, the Methodist Mines, the Midland Mining Company, and the Sphalerite Mining Company. Coleman Brothers, in prospecting the Randall tract, found good ore at 300 feet, and, according to report, I. N. Manley, in drilling southeast of Aurora, found ore at 400 feet.

Carl Junction and Sherwood districts.—The Mohler-Smith Company operated the old Lehigh ground and made a good output of zinc blende. The construction of a modern 300-ton mill was begun. Joseph Story and the Jubilee Mining Company operated the Avondale Land and Mining Company's tract. Robertson & Stuckey were also producers. The H. L. Kramer Mining Company commenced the erection of a 250-ton modern concentrating plant on the Lochrie tract, 2 miles northwest of Carl Junction. Ore was found at a depth of 210 feet, but much trouble was encountered in sinking the shaft on account of water. Creller & Young made a good production of lead and zinc concentrates, operating a 100-ton mill. J. Engleberry cleaned up a good output of ore on hand jigs. Other producers were the E. B. and G. Mining Company, and the Johnson land.

Carthage district.—The Consolidated Troup No. 2 and No. 3 mines, near Carthage, made a good output of zinc blende. The Hayseed Mine turned out a fair output of sphalerite. Other producers were the Vesuvius Mining Company, the Hudson Mining Company, the Waddell Zinc Company, and the Cash Mining Company. The King Pin Mining Company erected a mill just southeast of Carthage, but it was not operated during the year. The Carter land and O'Neil land adjoining the old Linzee diggings were actively prospected during the year. Drilling was actively prosecuted between Carthage and Alba. Good strikes were reported on the Weaver and Harris farms, about 4 miles northwest of the city.

East Hollow, Zincite, and Cave Springs districts.—The tract of the Belleville Land and Mining Company was operated by the Columbia Mining Company, the Midnight Mining Company, and the Brainstorm Mining Company. Mills were erected at the Columbia and the Midnight mines. In the latter mine a large cave lined with crystals of sphalerite and galena was broken into. The old Standard Hill and Lead Hill was reopened and a small production turned out. The East Hollow Mining Company, operating the Wyssbrod land, made a fair output. Other producers were the Eastern Illinois Mining Company, Mallet, Sansome & Staples, and Parkinson, Graves & Harper.

At Cave Springs the United Zinc Companies operated the Tuna mill for two months, after which it was removed. The Consolidated Troup Company opened No. 4 mine on the Fitzer land and made a small output. The Miami Mining and Realty Company completed the inclined shaft to a depth of 300 feet and began production. The Midsummer Mining Company and O. Miller & Co. were also producers.

Duenweg-Porto Rico district.—During 1907 a number of large modern mills to operate on sheet-ground ore were erected between Duenweg and Porto Rico, but most of them were compelled to close down by the low price of ore before making large outputs. Among them were the Good Samaritan, the San Gabriel, the Deacon, the Highland, the Tenderfoot, and others.

The Ground & Irwin 80-acre tract had the largest production of any land in this district. It was the output of 8 mills, including 1 sludge and 1 tailing mill. The output of the Trinity Zinc, Lead and Smelting Company's land was made by the Deacon, the Chapel, and the Whitsett mills, chiefly by the last two. The Whitsett mill and lease was sold to the Old Dominion Mining Company in November for a reported consideration of $65,000. The Church-Mitchell Company, operating on the Acme Lead and Zinc Company's land, completed a modern 250-ton mill in May and operated steadily until the close of the year. The Stevison-Rogers Lead and Zinc Company, operating 2 mills, each of 300 tons capacity, made a good production of lead and zinc concentrates. On the Chase land, the King William and the Royle ran about half time, making a fair production of zinc blende. The output of sublessees on the Crown Crest tract consisted of galena, lead carbonate, blende and zinc silicate, and carbonate, each in considerable quantity, making a fair total production.

The Gussie K. mine of the Federated Mines and Milling Company; the Common Sense lease on the Horton land; the Mercantile Metal Milling Company Nos. 2 and 3 on the Phil Chew land; the Reliance Mining Company Nos. 1 and 2; the S. D. Mitchell land; and the Swayback Mining Company, operating a 300-ton mill in the Porto Rico neighborhood, all reported a good production of lead and zinc concentrates. Among other producers in the district were the Magnolia, Bonnie L., Bonnie Pattie, Ruth Gradelle, Boston-Duenweg, Franklin, Hall Land, Hyde Park, Old Colony, O'Neill Land, Sadtler, and Sayers Mining companies.

Granby district.—Most of the producing territory at Granby is the property of the Granby Mining and Smelting Company, which subleases mining tracts to individual operators. The large output for the year consisted of galena, zinc blende, and zinc carbonate and silicate, the last two largely in excess.

The Mears Mining Company, operating the Mascot and Homestake mines, has a milling capacity of 300 tons. A fair production, with zinc blende predominating, was reported.

There was active prospecting in the vicinity of Granby during the year, and the discovery of ore bodies at considerable depth was a feature. Northeast of the old Mount Pleasant mill ore was struck at from 300 to 320 feet. Southeast of Granby on the Quimby land ore is reported at from 208 to 300 feet, besides at higher levels. Drilling on the Granby land indicated a run of ore at about 300 feet. Good strikes were reported in the vicinity of Ritchey, 4 miles northeast of Granby.

Joplin district.—A feature of the early part of the year was the development of new areas of sheet ground in the region west of the city. On the Continental tract it was found to occur at from 200 to 220 feet, and the Temagami shaft was sunk to it. On the Adirondack west of the Continental it was struck at 210 feet. Farther west toward Central City, the Luke, Columbia, Hero, and Paragon worked the sheet ground; and west of Chitwood the Old Times Lead and Zinc Company reopened the old Black Cat sheet ground. Exploration with the drill is reported to have shown the mineralized area to be practically continuous. Sheet ground was also reported in drilling on the John Jackson farm southwest of Central City.

The Adirondack Lead and Zinc Company, operating a 200-ton mill, made a good output of lead and zinc concentrates. The Continental tract made its usual large output of lead and zinc concentrates. The Temagami Mill was buried by a cave in in February, but was replaced by a new mill in September. The Prairie Chicken Mine on the Murphy and Connor land, made a good production of zinc ore. The mill of the Bullfrog Mining Company, which burned May 12, was replaced by a new 225-ton plant in September. The production was considerably curtailed by this interruption. The Granby Mining and Smelting Company's land made a large output of lead and zinc ores. The year was notable for the development of shallow lead deposits in Leadville Hollow and elsewhere.

The John Jackson Investment Company's land likewise made a large production, to which the Joplin-Kentucky Mining Company was the largest contributor, others being the John Jackson, the

Keno, the Kron Prinz, and the Cyclone. The Leonard Royalty Company and the Long Mining Company, operating northwest of Joplin, each reported a good production. The Marion B. lease, with three subleasing companies operating on the tract, made one of the large outputs of the district. On the Jackson Armil land, west of Blendeville, the Eden, Ruth, and Evansville No. 2 mines had a good output, chiefly zinc blende. The old Eagle tract, south of Blendeville, was operated during the year, making a good output of zinc ore. On the W. E. Johnson land, west of the city, there are four 100-ton mills, the total production of which was a fair output for newly developed ground. The M. I. and O. Company operated in the vicinity of the old Jackson Diggings and made a good production of zinc blende.

The Missouri Lead and Zinc Company reported the usual large output, the product of numerous lessees on the "Bankers' land" tract. The Roaring Springs Land and Mining Company, operating an adjoining tract in the southeast part of Joplin, made a fair production of lead and zinc concentrates. The Rex Mining and Smelting Company, owners of the Thousand Acre tract, reported one of the large outputs of the district. The tract was subleased to six operating companies, with a combined milling capacity of 500 tons.

The Montgomery Lead and Zinc Company's land, subleased to the Le Roy No. 1, the Goodone, and the Hemphill Mining Company, made a good output of zinc blende. The Pittsburg-Joplin Lead and Zinc Company had a good output both of lead and zinc. The Pittsburg-Missouri Lead & Zinc Company reported one of the large productions of the camp from its tract. The Paragon Mining Company, working sheet ground in the region west of town, made a good output of lead and zinc concentrates. The United Zinc Companies reported a large production for the 80-acre tract at Chitwood, made by the Conqueror, the King Jack, the Gibson Girl, and the Spring River No. 1 mines, and including the output of 2 tailings mills.

Among the producing mines and lands not mentioned above were the Chapman, Alice of Old Vincennes, Advalorem, Big Hurricane, Grundy Realty Company, Hancock, Ideal, Iroquois, Bumble Bee, Monroe, Osceola No. 3, Paoma, Walker, and Weyman lands, and many others.

Oronogo district.—In the Oronogo-Duenweg sheet-ground belt the mining is practically continuous throughout, so that the division lines of the districts are necessarily arbitrary. For convenience the Oronogo district is in this report considered to be limited to the region north of Center Creek. The producing territory in this region is mostly owned by the Granby Mining and Smelting Company, which reports its customary large output. Starting in the old circle deposits with shallow lead at the grass roots, the ore has been followed downward until the sheet-ground horizon has now been reached. The Old Judge Mining Company reported a fair production for the year. The construction was begun of a new modern 250-ton mill to replace the small mill heretofore in operation.

Sarcoxie-Reeds district.—The mines in the district lie between the two places, and while the ore is usually shipped from Reeds, the owners or operators generally live in Sarcoxie. The Optimo Lead and Zinc Company made a good production of high-grade zinc concentrates from the J. P. Boyd land. The O. K. Mining Company and others were also operating on the Boyd land. The Cameron Mining Company, operating on another part of the Boyd land, was engaged in prospecting and made no output. The Plymouth Rock mine on the Goucher land was operated for only a portion of the latter half of the year and made a small output.

Spring City-Beef Branch district.—Though less than a mile apart the ore deposits of Beef Branch are very different from those of Spring City. The ores mined at the former camp are shallow lead and zinc carbonate and silicate, while those mined at Spring City are lead and zinc blende. Though the ore deposits of both camps have been worked for several years, it was during 1907 that the Spring City camp had its greatest development. Prospecting was very active and several strikes of ore were made which will undoubtedly develop into producers in 1908.

The Alpha Mining Company on the Adam Scott lease made a large production, the largest of the camp. The Argosy Mining Company and the Sunrise Mining Company, on the same lease, also made good outputs. The Alladin Mining Company made a good production of zinc on the adjoining St. Paul tract. McKinney & Co. on the Hoge land made a fine output of silicate ore. The Bales, Henderson, Chalmondeley, Armil, and Allen lands were also producers.

The Auburn Mining Company sunk a shaft to ore at 260 feet and built a 250-ton mill near Hornet, 2 miles southwest of Spring City. The mill was not operated except for a test run. The Pinnick mines, located near the state line, 8 miles southwest of Spring City, reported an output of zinc silicate.

Springfield district.—The Springfield mines are located on Pierson Creek, about 5 miles southeast of the city. The ore is reported to occur in channel or crevice deposits from 5 to 40 feet in width and 1,600 or 2,000 feet in length. The ore is galena and sphalerite, the concentrates of the former assaying 82 to 83 per cent metallic lead, and the zinc concentrates assaying 63 to 64 per cent metallic zinc. The Rathbun Mining Company was succeeded in midyear by the Daisy Mining and Milling Company, the combined production representing a good output. The mine is equipped with a 100-ton mill. The Badger Lead and Zinc Company started operations about the middle of September and made a fair output of lead and zinc concentrates before the close of the year.

Spurgeon district.—The H. E. Bucklen land made a good production of lead ore and zinc blende and silicate. The mines in operation were the Bonnie Pearl and the Blue Bird. Concentration was made on 100-ton mill and hand jigs. The Bucklen & Wills land, consisting of the Knoxall, the Easy Street, and the Old Spurgeon tracts, made a fair production of zinc concentrates. The mines operated were the Tiger, the Hub, the Quaker Maid, and the Missouri Girl, the last two having 100-ton mills each. The Granby Mining and Smelting Company reported a good output of lead and zinc blende and silicate from the Granby tract equipped with a 100-ton mill and operated by the Estewawa Mining Company and the Home Mining Company. The

Moseley Lead and Zinc Company, operating the old Moseley diggings southeast of Spurgeon, worked steadily until the decline in ore prices. A good production of lead and zinc blende concentrates was reported.

Several mines southwest of Spurgeon, along or in the vicinity of the Seneca fault block, are included here for convenience. The Buzzard diggings on the Newman land, 3 miles northeast of Racine, report a production of zinc blende and lead cleaned on hand jigs. The Chandler Mining Company, operating 2 miles northwest of Racine, completed a 70-ton mill in December, and made a small output of zinc blende before the close of the year. The DeMasters Mining Company, operating on the Olson, now the Aylor land, just west of the Chandler Mining Company, made a fair production of zinc blende which was cleaned on hand jigs. The old Holmes and Potwin mines, 1 mile south of Seneca, were acquired by G. and B. T. Becker, who erected a 150-ton concentrating plant. Prospecting and development work were carried on extensively.

Stotts City district.—The mines at Stotts City are situated on a north and south line along the valley of a small stream. The ore is practically all zinc blende, a little galena occurring in a single mine. Considerable pyrite occurs in some of the mines, and a carload was shipped during the year.

The Julia West Mining Company made a small output of lead and zinc concentrates. The mill has a capacity of 150 tons. The Mount Vernon Mining Company holds the first lease on the Stott land, subleasing to the Keystone, Illinois, Small Hope, and Mount Vernon companies. There are 4 concentrating mills on the lease, with an aggregate capacity of 500 tons. Each mill was in operation for a part of the year, and the total production of zinc blende reached a good figure. The Golden Jack Mining Company is operating about 2 miles south of Stotts City. The mine, with 150-ton mill, was worked for only a part of the latter half of the year.

Wentworth district.—The Gobbler Mining Company operated the Gobbler Mine on the Empire Zinc Company's land just south of Wentworth for the last half of 1907, and made a fair production of zinc blende with a little lead and silicate. The mine is equipped with a 150-ton mill. The Benua Mining Company acquired the Gamecock mine in August, after which it was operated but one week. Previous to the change it had made a fair output of zinc blende. The mill has a capacity of 150 tons. The Annie D. mine, after making a small output, was abandoned.

Webb City-Carterville-Prosperity district.—This district includes the section of the Oronogo-Duenweg sheet-ground belt between Center Creek and Porto Rico, embracing the original and typical sheet-ground territory.

The Underwriters' Land Company operates the Golden Rod mill of 250 tons capacity, and the Marigold, popularly known as the "Yellow Dog" mill, of 1,000 tons capacity per 10-hour shift. The latter mill is the largest in the district and is composed of 2 independent units of 500 tons each. Each unit is connected with the mine by an inclined shaft and the ore is raised by link-belt conveyors. The output for the year was large. The Guinn land made a large output of lead and zinc ore, the production of the Electrical, Rhea, McCroskey, Ground Floor, Black Cat, Osceola No. 2, Mercantile, and Ice Plant mining companies. The Rochester Land and Leasing companies reported a large production of lead and zinc concentrates and also the Providence Mining and Milling Company, operating a mill of 400 tons capacity. The Winslow Mining Company has 2 mills, a new one of 350 tons capacity and another one of 150 tons. The small one was operated for the greater part of the year, but the new mill operated only a month. Other companies operating north of Webb City which made a good production of ore in 1907 are the Engineers Zinc Company, with a mill of 200 tons capacity; the Gibson Mining Company, with a 250-ton mill; the Carter land, operated by the John L. and the Big Stick mining companies; the Majestic Mining Company, operating a mill of 150 tons capacity; the Vantage Lead and Zinc Company; the Osceola No. 1, operating on the Kelly land, and the American Beauty Mining Company, with a mill of 200 tons capacity.

Among the companies operating in the territory between Webb City and Carterville which report a good output for the year are S. Y. Ramage, operating the Morgan Forty; the Bradford and Kansas City Zinc Company, with a 400-ton mill; the Center Creek Mining Company, operated by the Mercedes Mining Company, and various other lessees; the Charter Oak Mining Company, and the Missouri Zinc Fields tract, subleased to three operating companies with a milling capacity of 500 tons. In the vicinity of Carterville and Prosperity, and south of those places, are several tracts which made a large production. Among these were the Davey and the Cornfield tracts, operated by the American Zinc, Lead, and Smelting Company, which made the largest output of the district. Five mills were operated, with an aggregate capacity of 2,500 tons, as follows: Nos. 1, 2, and 4, 500 tons each; No. 3, 750 tons; No. 12, 250 tons. The Aylor Forty reported a large production of lead and zinc, the output of several concentrating plants on the tract. A large production was also made by the Burgner Mining Company's tract. The Continental Zinc Company, operating the Litteral tract, made a good production of lead and zinc ore, the output of various subleasers, and of the new 300-ton Continental mill completed in June. Another large producer was the General Lead and Zinc Company's tract, operated by the George H., the Goodrich, the Eleven O'Clock, and the Twelve O'Clock mining companies, with milling capacity aggregating 550 tons. The Eleventh Hour tract yielded a good output of lead and zinc ores, the product of various lessees. The Connor land also made a good output, the product of the McKinley, Katy C., Black Diamond, Ten O'Clock, Plutocrat, Croesus, and Mount Ararat mines. Among the other mining tracts and companies which produced in 1907 were the Minerva Lease, Louis W., Little Princess, Luscombe Land, Portland, Sucker Flat, Talisman, and Hansel mines.

CENTRAL AND SOUTHEAST MISSOURI.

The ore deposits of central and southeast Missouri reach in a more or less connected belt from the region of Morgan, Moniteau, Cole, and Miller counties on the northwest, to the northern and eastern flanks of the St. Francis Mountains on the southeast. The deposits in the northwestern portion of this belt are of the general type of those in the Joplin region; that is, they consist of sphalerite and galena, or the oxidized derivatives of those ores. They occur in association with such effects of solution as breccias and shale patches, the ore being found either in the limestones and dolomites, or in the Pennsylvanian shale. Around the St. Francis Mountains, however, the ores are different in their mineralogical association as well as in their structural relations. In this area the lead generally carries some silver, and in places, particularly in the vicinity of Fredericktown and Mine La Motte, is associated with sulphide ores of copper, nickel, and cobalt.

The copper, nickel, and cobalt ores occur with lead in blanket formation in the beds of parting at the contact of the Bonne Terre limestone with the La Motte sandstone below, and in the vicinity of the intersection of this contact with the sloping surface of the pre-Cambrian rocks. The lead, when alone, occurs in the lower part of the limestone. It forms in joints and crevices, and the ore bodies are sometimes of great linear extent. The ore also impregnates the adjacent country rock. The crevices show little, if any, displacement, and no breccia of consequence.

The southeast Missouri deposits have been known and worked for about 200 years. The earlier workings were shallow, and even yet considerable shallow lead is raised, generally in connection with the mining of barytes, or "tiff," as it is locally known. The larger mines are from 250 to 500 feet in depth, and shafts are now being sunk to a depth of 700 feet. Prospecting is done by means of the diamond drill, and extensive campaigns of drilling have been prosecuted in the vicinity of all the important producing tracts. Just before the panic of 1907 there were nearly 100 diamond drills actively employed in prospecting. Attempts were made to explore the territory beneath some of the old shallow lead diggings in Washington County, though as yet no connection has been shown between the shallow deposits and the deeper disseminated bodies.

The silver production of Missouri—25,692 fine ounces—was recovered from 35,369 tons of lead concentrates from the mines of southeast Missouri. This represents about one-fifth of the total concentrates; most of the remaining four-fifths was not desilverized, except a few small lots, of which no account was kept, as to the silver. The average silver content calculated from the returns made was 0.726 ounces to the ton of concentrates.

Moniteau County.—The Missouri Lead Company, operating 5 miles northeast of California, Moniteau County, has a 100-ton concentrating plant of modern design. The ore is mainly lead, and is found at a depth of 73 feet. A small production was turned out during the first part of the year, and the mine was not worked during the last half.

The Monarch Coal and Mineral Company is working a remarkable deposit of cannel coal, lead, and zinc near Barnett, in Moniteau County. As frequently happens in the coal pockets of central Missouri, the coal reaches a great thickness, here from 40 to 50 feet, and in parts of the pocket is 70 and 100 feet in thickness. The ore is reported to occur in the coal to a certain extent, but principally adjacent to it. The mine is equipped with a small mill, which made a fair production of lead and blende concentrates in 1907.

Jefferson County.—The Valle Mining Company owns a tract of mining land in Jefferson and St. Francois counties, which is leased to individual small operators. The ore is cleaned entirely by hand. The company reported a good production of lead and zinc "silicate" for 1907.

Crawford County.—The Missouri Copper Mountain Mining Company has mines near Sullivan, Crawford County, and is one of the three companies which mined copper ore in Missouri in 1907. The concentrating mill has a capacity of 100 tons, and is equipped with a log washer, four jigs, and a Wilfley table. There is also a 36-inch water jacket blast furnace for reducing the copper ore. A small production of lead, copper, and iron ores was made in 1907, but the copper ore was not smelted.

Washington County.—The Abbeyville Mining and Smelting Company, operating in the northwest part of Washington County, made a small production of lead ore which was cleaned on hand jigs. The American Lead and Barytes Company has large tracts of mining land in Washington County, near Potosi and Cadet, containing shallow lead diggings which are leased to small operators. The company is now in the hands of a receiver, who reported a small production of lead ore for 1907. The Renault Lead Company, owning a large tract of mining land near Palmer, Washington County, reported a small production of lead ore from shallow diggings in 1907. The Southeast Missouri Lead Company has mining land in Washington County on which there is a small concentrating plant. The land is leased to individual miners, who made a small production of shallow lead in 1907.

There are numerous shallow lead and barytes diggings scattered over Washington County, which are worked by small operators who sell their product to the country merchants.

St. Francois County.—Almost the whole output of lead ore of southeast Missouri was produced by the mines near Bonne Terre and Flat River in St. Francois County.

The St. Joseph Lead Company maintained the position, held for a number of years, as the greatest lead producer in the district. The mines are at Bonne Terre, which is connected by the company's railroad 50 miles in length with the St. Louis, Iron Mountain and Southern Railway at Riverside, on the banks of the Mississippi, giving the benefit of water transportation. The 2 concentrating plants have a combined daily (twenty-four hours) capacity of 2,600 tons. The smelter at Herculaneum, 30 miles north of the mines, is equipped with 2 modern furnaces and 5 Savelsberg roasting pots. Numerous improvements were made around the mines and in the company's model mining town, and the construction was begun of a new power plant in which gas-producer engines will replace the steam plant now in use.

The Doe Run Lead Company is affiliated with the St. Joseph Lead Company and turns over its output to that company for smelting. In the early part of 1907, tracts of land owned by the Union

Lead Company and the Columbia Lead Company, after being thoroughly prospected with the diamond drill, were purchased by the Doe Run Company and added to its holdings. The Mitchell shaft was completed during the year, and an old shaft near Flat River was reopened. The concentrating plant of the Doe Run Company has a daily capacity of 900 tons. The 300-ton Columbia mill was overhauled and put in operation. Foundations were laid near Elvins for a large modern mill to handle the ore raised at the Mitchell shaft.

The Desloge Consolidated Lead Company's mines are near the town of Desloge, which is situated on land belonging to the company. The concentrating plant has a capacity of 1,000 tons per day, and is equipped with a full complement of jigs and tables. Shaft No. 5, which was completed during the year, is 8 feet by 21 feet in size. Its location is 5 miles from Desloge, with which it is connected by a standard-gage railroad.

The St. Louis Smelting and Refining Company operates mines near Flat River. There are 5 shafts, the ore from which is milled over a concentrating plant of 1,600 tons capacity per day of twenty-four hours. The mill is equipped with Hancock jigs, Frue vanners and Overstrom tables, and Richards pulsator classifiers will be added. The power equipment is considered to be the most economical in the district. A central steam plant drives the compressors and electric generators. The mill, hoists, and pumps are operated by electricity, as well as the electric trams for handling the ore from the shafts to the mill. A new shaft was completed during the year and electric haulage installed underground.

The Federal Lead Company, at Flat River, operates 8 shafts, 3 of them on the tract formerly owned by the Central Lead Company. The old Central mill was replaced by a new mill of 2,400 tons capacity in 6 independent units of 400 tons each, the largest concentrating plant in the Central States running on lead or zinc ores. The mill is equipped with a full complement of modern jigs, Frue vanners, and Wilfley tables. The old mill has a capacity of 800 tons, giving a total daily capacity of 3,200 tons. The Central smelter has been dismantled, and concentrates are now shipped to the company's smelter at Federal, Ill. One shaft was completed during the year, and two others are under way to reach an ore body at a depth of 700 feet. Electric underground haulage is installed, and two standard-gage locomotives bring ore from the distant shafts to the mills.

Madison County.—The North American Lead Company at Fredericktown partly completed its smelting plant in February and began the production of blister copper. The electrolytic refining plant was finished in part by October, and some cathode and electrolytic ingot copper was made. The whole plant was continuously in course of construction and adjustment throughout the year, and was not expected to be complete until the middle of 1908.

According to the Report of the Missouri Bureau of Mines and Mine Inspection for 1906, the smelting plant consists of a blast furnace, 2 mechanical roasting furnaces 2 hand-rabbling roasting furnaces, and 1 copper-refining furnace, the whole having a capacity of 100 tons of concentrates per day. When fully completed the output of the whole works is expected to be about 150,000 pounds of copper, 60,000 pounds of nickel, and 20,000 pounds of cobalt oxide per month, exclusive of lead concentrates which will not be smelted by the company.

The ore consists of an intimate mixture of the sulphides of copper, lead, nickel, and cobalt, and iron in the form of chalcopyrite, galena, linnæite, and pyrite. The lead, as far as possible, is removed in concentration, the iron is removed by roasting and magnetic separation, and the resulting concentrate is smelted in the furnaces. Owing to the construction work in progress the output of lead concentrates was very much restricted during the year.

The Madison Lead and Land Company near Fredericktown is operating the mine formerly known as the Catherine. There are 2 shafts, 100 and 160 feet in depth, respectively. The old mill of 200-ton capacity is located on the bank of the Little St. François River and is connected with the mine by a long aerial tramway. A new mill of 300 tons capacity was built at the mine in 1906. The capacity will be further increased to 800 tons in 1908. The mills are equipped with Hancock jigs, Overstrom tables, and double-deck buddles 18 feet in diameter. The ore bodies are in the limestone and yield about 6 per cent of lead concentrates, no copper or nickel-cobalt sulphides of consequence having as yet been found.

The Hudson Valley Lead Company's mine is located near Mine La Motte station, about 3 miles from Fredericktown on land leased from the Mine La Motte Lead and Smelting Company. It is operated both by shaft and by incline, ore being hoisted by the former, and the men entering the ground by the latter. The mill has a capacity of 200 tons and is equipped with jigs and Deister concentrating tables. The copper and nickel-cobalt sulphide ores occurring with the lead ore are stored awaiting the market which the smelter at Fredricktown will make for ore of this class.

The Mine La Motte Lead and Smelting Company is operating on deposits which were first located in 1720. The shallow deposits at first worked were followed down to a depth of about 100 feet, from which level the ore has been coming which for fifty years has supplied the mill and smelter. The old mill of 250 tons capacity is equipped with jigs and concentrating tables. The construction was begun of a modern 500-ton mill to be completed early in 1908. Pending the improvement, the output of lead concentrates was cut down considerably. The smelter was not operated in 1907. Certain areas in the mines of this company yield the copper and nickel-cobalt sulphide ores. These were formerly smelted by the company, but recently have been avoided, attention being limited to the lead ores.

The Wheeling Milling Company operates a tailings mill on the Mine La Motte tract, treating the tailings which have accumulated in a long period of operation. The mill has 250 tons capacity, and is equipped with Hartz, Cooley, and Hancock jigs and Standard concentrating tables.

OKLAHOMA.

By C. E. Siebenthal.

PRODUCTION.

The production of lead and zinc in Oklahoma in 1907 is shown in the following table:

Production of lead and zinc in Oklahoma in 1907, by districts, in short tons.[a]

District.	Ores.								Metal content.			
	Lead concentrates.				Zinc concentrates.				Lead.		Zinc.	
	Galena.		Carbonate.		Sphalerite.		Carbonate and silicate.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Quapaw	647	$43,644	......	......	3,062	$118,440	97	$1,631	518	$54,908	1,495	$176,410
Peoria	15	1,127	5	$275	14	568	553	14,036	14	1,484	162	19,116
State total.	662	44,771	5	275	3,076	119,008	650	15,667	532	56,392	1,657	195,526

[a] The small production of the single mine in operation in the Miami district for a short time in 1907 is included in the figures of the Quapaw district, to avoid disclosing individual business. In calculating the metal content of the ores from assays, allowance has been made for smelting losses in case of zinc, but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the metal is calculated from the average daily quotations at New York.

The workable deposits of lead and zinc in Oklahoma, so far as known, are confined to the northeastern portion of the State, within the limits of Ottawa County. They form the southwesternmost extension of the ore deposits of the Joplin region. They occur chiefly in flint breccias, but occasionally in limestone and sandstone breccias. The ores are galena, sphalerite, or zinc blende, and zinc carbonate and silicate. The galena is practically nonargentiferous, never containing as much as an ounce of silver to the ton of lead concentrates.

PEORIA DISTRICT.

Messrs. Gordon & Wilkins, operating the Silicate mine, made a good output of zinc carbonate. The ore is sluiced, hand jigged, and hand culled, and is a high-grade carbonate. The Chicago Syndicate Mining Company leased a portion of the Geboe tract, and erected a 150-ton mill, which was completed just as the panic came on. It was operated only for a short test run. Other prospects on the Geboe land made small outputs.

Prospecting was carried on with encouraging results on the Cowan lease just west of Peoria, and Messrs. Grimes & Williams struck a good prospect near the State line, 3 miles east of Peoria.

SYCAMORE DISTRICT.

Sporadic prospecting in the Sycamore district in the last few years has not up to date yielded results which would justify development.

QUAPAW DISTRICT.

The Quapaw ore deposits were first opened in 1903. At the close of 1907 there were 25 steam-concentrating plants and 7 hand-jig outfits in the district. As in other blanket ground the panic affected production disastrously.

The Western Mining Company leased the Sunnyside mine and mill and operated it during a portion of the year. The Ayers-Sloan Mining Company was in operation during the same time under the same management. The Eastman Land and Investment Company, operating the Grey Eagle mill, handicapped by the burning of hoister house and hopper, closed down to remodel the mill, which has a capacity of 150 to 200 tons and is equipped with 3 jigs and a Wilfley table. The Newlands Mining Company in May completed a 200-ton mill which was in operation until November, when it was closed on account of the drop in ore prices. The Kramer-Morse Mining Company continued development work, drifting from the northwest shaft toward the mill in order to strike the upper ground and to furnish better ventilation. The upper run proved to be very promising lead ground, and it will be operated in connection with the lower ground. The Mason Mining Company completed a 250-ton mill in July, but ran on half time because the mine was not opened up sufficiently to supply ore to run steadily. The M. K. & T. Mining Company ran very steadily and made the largest production of zinc ore in the district. The adjoining lease of the Ward Mining Company was consolidated with the M. K. & T. lease. The Mission Mine also ran very steadily and made the largest total production of the district, about one-third of the total product being lead concentrates. The company laid plans to erect a large mill to replace the one of 80-ton capacity now operated. The Hannibal and St. Joe Mining Company consolidated with the adjoining Quapaw Lead and Zinc Company in November, and the ore from both shafts will be run over the new mill of the latter company.

The Hobo, Omaha, Dark Horse, Joanna, Quivera, Old Abe, F. F. F., Monon, and Micawber mines, all except the first named equipped with mills, were operated intermittently during the year, being for the most part engaged in prospecting and development work.

New mills were built at the Indiana, Lancaster, Newlands, Spring River, McAllister, Common Law, Virginia, Quapaw, and Mason mines. The mills which were completed before the general closing down of the mines during the panic were operated intermittently, for the reason that the mines were not generally opened up enough to furnish sufficient ore to run the mills steadily. The Gatlin, Sunburst, Good Luck, Three Queens, Big Four, Cherokee, Alabama, and Chicago-Quapaw mines continued prospecting and development work. The Alabama installed a hand-jig plant and the Chicago-Quapaw decided to build a mill in 1908.

In drilling a public well in the town of Quapaw a good strike of zinc ore was made, which extended the known limits of the blanket ground a half mile westward beyond any previous development.

Miami district.—The Miami district is the youngest and most interesting camp in the Joplin region. The ore occurs in sandstone breccias and in flint breccias lying below the sandstone. The sandstone is impregnated with a heavy oil which, evaporating to asphaltum, causes much trouble in saving the concentrates. The ores are galena and sphalerite or zinc blende, no oxidized ores having yet been found. The mills and milling methods in vogue are of the usual Joplin type. The best results will not be obtained until these methods are adjusted to the peculiarities of the local conditions.

The New State Mining Company erected the first mill in the district. It was completed and in operation in August. The capacity is about 100 tons, and the equipment at the beginning consisted of rougher and cleaner jigs. Difficulty was encountered in handling the ore, and the addition of a concentrating table was made with good results. The plant was then closed down on account of the panic.

The Old Chief Mining Company reached ore in the shaft and completed a 100-ton mill near the close of the year. The Emma Gordon Mining Company sank 2 shafts to ore and erected a 250-ton mill after the type in use in the Webb City sheet ground. The plant was put in operation early in 1908. The Lawson Mining Company, the Buckeye Mining Company, the Banner Mining Company, and the Sullivan Mining Company had shafts in ore by the close of the year and were arranging to erect mills. The Lucky Strike Mining Company, the King Jack Mining Company, the Wauhillau Mining Company, the Index Mining Company, the Golden Hen Mining Company, and the Little Joe Mining Company were sinking shafts on promising drill holes.

WISCONSIN.

By C. E. SIEBENTHAL.

PRODUCTION.

The production of lead and zinc in Wisconsin in 1907 is shown in the following table:

Production of lead and zinc in 1907, by districts, in short tons.[a]

District.	Ore.						Metal content.			
	Lead concentrates.		Zinc concentrates.				Lead.		Zinc.	
			Sphalerite.		Carbonate and silicate.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Benton	1,250	$67,702	8,259	$148,715	1,445	$18,118	994	$105,364	3,487	$411,466
Cuba City	598	37,706	3,057	99,387	22	725	475	50,350	1,147	135,346
Dodgeville	145	9,666	949	25,692	104	1,709	115	12,190	383	45,194
Hazel Green	819	53,526	11,819	186,731	....	....	651	69,006	4,410	520,380
Highland	340	23,033	1,815	28,555	1,300	16,387	270	28,620	1,041	122,838
Linden	347	17,441	6,496	142,409	4	77	276	29,256	2,425	286,150
Livingston	248	15,401	4,189	76,762	50	1,000	197	20,882	1,577	186,086
Mifflin	46	2,256	2,398	63,416	....	....	37	3,922	895	105,610
Mineral Point	265	16,290	2,346	47,285	140	2,406	211	22,366	915	107,970
Shullsburg	97	5,880	1,058	23,114	....	....	77	8,162	395	46,610
Platteville	205	14,520	4,865	155,061	....	....	158	16,748	1,815	214,170
Potosi	48	3,050	....	....	....	....	38	4,028	....	....
State total	4,408	266,471	47,251	997,127	3,065	40,422	3,499	370,894	18,490	2,181,720

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[a] The production of single mines at Buncombe, Calamine, and Montfort is included with the production of Shullsburg to avoid disclosing individual production. In calculating the metal content of the ores from assays allowance has been made for smelting losses in case of zinc but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, and that the value of the metal is calculated from the average daily quotations at New York.

The lead and zinc mines of Wisconsin are in Grant, Iowa, and Lafayette counties, and comprise the most important part of the ore deposits of the upper Mississippi Valley region. The ores are galena, sphalerite, or zinc blende, and smithsonite, zinc carbonate, locally known as "dry bone." As a lead region the district has been known from the earliest settlement days. In time the building of smelters near by made a market for the zinc ores. The first zinc ore to be mined was the carbonate found in association with lead in the shallow workings above ground level. When all the main desposits were worked out down to water level, there was a lull in mining in the region. Though the carbonate was known to give place to zinc blende and the lead to continue on below water, it was not deemed profitable to mine when continued pumping was necessary. About eight or ten years ago the higher price of zinc led to the opening of some of the deposits below water level, since which time zinc mining has increased until Wisconsin for 1907 stands fourth in rank among zinc-producing States. The ore bodies are found in perpendicular, horizontal, or inclined cavities known as "openings" or "crevices," "flats," and "pitches." These openings sometimes extend for considerable distance in a straight line called a "range," and may be operated at different places by different companies. When a range is once established, it becomes an important guide in prospecting.

The galena of the district is nonargentiferous. In some of the mines marcasite is so plentiful that the zinc blende concentrates are reduced to a very low grade. Owing to their nearness in specific gravity, marcasite and blende are very difficult to separate by hydraulic methods. Both electrostatic separation and roasting with magnetic separation are in operation. Twenty-five concentrating plants in the district are equipped with roasters and magnetic separators, in addition to which the Joplin Separating Company, at Galena makes a business of separating low-grade blende-marcasite ores. The concentrates after being dried are roasted in a long, slowly revolving cylinder lined with fire-brick. The roasting is carried far enough to render the marcasite magnetic, but not to drive off all the sulphur, after which the concentrates are passed under the magnetic separator and the iron is removed. At Platteville, late in 1907, there was begun the construction by the American Zinc, Lead, and Smelting Company of a 100-ton electrostatic separator equipped with dryer, 3 Blake-Morscher machines, and 4 Type A Huff machines. In this plant the expense of roasting and the loss therein are saved, and the separated marcasite is a merchantable product.

Milling practice is much as in the Joplin region, except that everything is on a much smaller scale in Wisconsin. The mills are many of them from 35 to 50 tons in capacity, and have but a single jig. Those of 100 tons or over, with rougher, cleaner, and sand jigs and concentrating tables, have generally been built in the last few years. There were in the neighborhood of 50 new concentrating plants erected in 1907, many of them being of the larger size. The crude ore yields from 5 to 20 per cent, or more, of zinc concentrates. The contracts, in the case of the larger mills, generally call for a saving of 85 per cent of the blende in the crude ore, but very likely in practice this figure is not often attained. The mining methods are largely determined by the mode of occurrence of the ores, but otherwise are similar to those in vogue in working the disseminated ores at Joplin.

The zinc carbonate ore is all taken by the Mineral Point Zinc Company and made into zinc oxide in the plant at Mineral Point, Wis. A considerable amount of the low-grade zinc blende concentrate is used in the same way. Only the higher grade zinc blende concentrates are sold for manufacture into spelter.

The writer takes pleasure in acknowledging the assistance of Prof. R. B. Brinsmade in securing the statistical mine data for Wisconsin.

Benton district.—The Amalgamated Zinc Company operated the Empress mine, equipped with a 100-ton mill, producing zinc blende, and the Jughandle-Open Cut mine, with a 150-ton mill, producing zinc carbonate. A 30-ton roaster and magnetic separator was added to the Empress plant in June. The Monarch Zinc Company, operating a 100-ton mill, was consolidated with the Amalgamated Zinc Company in November.

The Benton Mining and Development Company completed a new mill in January. It is of the Joplin type, with 60 tons capacity. The Corr Mining Company completed a 50-ton mill in June, and made a large production of lead, opening up also, it is reported, a large body of zinc carbonate. The Etna Mining Company erected a 150-ton mill, which began operation in July and made a fine output of zinc blende. The Fox Lead and Zinc Company built a 75-ton mill, which made a short run and then closed down to install new pumps. The Frontier Mining Company entered the ranks of the producers in April, when the new 75-ton mill was completed. The Grant Mining and Lumber Company completed Grant No. 1 (Star) mill with 75-ton capacity in April, and began the erection of Grant No. 2 (Swift & Rooney), to have a capacity of 100 tons. This mill was nearly finished when the decline in ore prices stopped all work. The Mifflin & Linden Mining Company began the construction of a 100-ton mill at the Ollie Belle mine, which was not yet finished at the close of the year. The Madison Exploration Syndicate erected a 40-ton mill. The Emerald and Looney mines were among the producers for the year.

Cuba City district.—The Baxter Mining Company has a mill and full equipment, and made a good production of zinc concentrates during the year. The Best Mining Company completed a 100-ton mill in September and made a small production of lead. The Wilkinson mine reported a good production of lead for the year. The Dall Lead and Zinc Company made a good output of lead and zinc concentrates with their 100-ton mill. A roaster and magnetic separator was added to the equipment in February. The Henrietta Mining Company began the construction of a 50-ton concentrating plant, which was not completed at the close of the year. The Meekers Grove Mining Company completed a 75-ton mill in December. The Rico Mining Company erected a mill which was completed and in operation in October. The Roosevelt Mining Company added a new roaster and magnetic separator to its equipment. The Vandeventer Lead and Zinc Mining Company began the erection of a 100-ton mill, which was not completed at the close of the year. The Midway Mining Company completed a mill in November, and the Jarratt Lead and Zinc Mining Company began the erection of one late in the year.

Dodgeville district.—The Blue Mounds Mining and Smelting Company was largely engaged in construction and development work during the year, but reported a small production of zinc ore concentrated on a 25-ton mill. The McKinlay Zinc Mining Company started its 50-ton mill in May, operating both inclined and main shafts. The Rising Sun Lead and Zinc Company completed a 25-ton mill, and reported a small production of zinc blende and lead concentrates. The Snowball Mining and Milling Company, operating a 50-ton mill, made a fair production of lead and zinc concentrates. The Conservative Lead and Zinc Mining Company operated the Williams mine, equipped with a 50-ton mill and electric drills. The Western Belle mine has changed hands, and is now the property of the Curry Lead and Zinc Mining Company.

Hazel Green district.—The Hazel Green branch of the Chicago and Northwestern Railway was completed to Hazel Green in October, giving better transportation facilities.

The Kennedy Mining Company, operating a 100-ton mill equipped with roaster and magnetic separator, was a consistent producer throughout the year and had a fine output of zinc blende concentrates and considerable lead. The Murphy Mining and Development Company completed a 150-ton mill in September, 1907, and operated it for two months. It is equipped with 3 jigs, roaster, magnetic separator, and air compressor. The Mills Mining and Reduction Company is equipped with a 200-ton mill, roaster, magnetic separator, air compressor, and everything complete, at a reported cost of $73,000. The mine made the largest production of the district in 1907.

The Square Deal Mining Company, operating a 100-ton mill, and the Winnebago Mining Company each made a good output.

Highland district.—The construction of 32 miles of railway from Mineral Point to Highland has given the large producers of zinc carbonate in that district direct connection with their natural market, the zinc oxide works of the Mineral Point Zinc Company.

The Franklin Mining Company, operating a 40-ton mill equipped with concentrating tables and driven by gasoline, reported a good production of zinc blende and zinc carbonate. The mill of the Highland Mining Company was destroyed by fire August 30, 1907. A new mill was contracted for, to be finished by the close of the year. At the Kennedy mine the same company completed an inclined shaft and contracted for a mill equipped with concentrating tables, to be completed early in 1908.

The Red Jacket Mining Company in September completed a mill equipped with Cooley jigs. The Clark mine of the Mifflin & Linden Mining Company, equipped with a 100-ton mill, made an output of lead and zinc concentrates. The Milwaukee-Highland Zinc Mining Company purchased the Chicago-Benton mill, and remodeled and installed it at the mine in August. The Minter Mining Company erected a 100-ton mill equipped with concentrating tables.

Linden district.—The plant of the Glanville Mining Company made a good production of lead and zinc blende concentrates, in addition to which considerable ore was milled for the Dark Horse Mining Company. The Platteville-Linden Mining Company completed a 75-ton mill in October, which ran about thirty days before closing down. The Linden (Mason) mine of the Mifflin & Linden Mining Company, beginning in February, was operated steadily until the general shut down, making a big production of zinc concentrates. The mill has a capacity of 100 tons. Ross Brothers, operating a 60-ton mill, reported a big production of zinc blende and lead concentrates.

Livingston district.—The Coker mine of the Mifflin & Linden Mining Company, equipped with a 100-ton mill and roaster, was in steady operation, and made a fine production of zinc blende concentrates and some lead. The La Follette Mining Company shipped some hand-cleaned lead and zinc carbonate ore. The New Crescent Mining Company operated their new 50-ton mill for a short time, making a small output. The Sunrise Mining Company reported a good output of zinc blende concentrates. The Sunset mine produced a considerable quantity of lead concentrates. The Dolan, Dietzman, and Cushman mine carried on development work.

Mifflin dstrict.—The Grunow Mining Company made a good output of zinc blende concentrates from its 50-ton mill. The Slack Mining Company completed a 50-ton mill late in the year and made a small production. The Peacock Mining Company was in operation and produced a fair quantity of good grade sphalerite concentrates.

Mineral Point district.—The Hazel Patch Mining Company's 100-ton mill was equipped with Cooley jigs in May and operated for a portion of the year, making a moderate output of zinc blende with some lead. A roaster and magnetic separator was added in September. The John Ross mine made a fair production of lead, zinc blende, and zinc carbonate. The Liverpool mine, equipped with a 40-ton mill, and the Tripoli Mining Company, operating a 60-ton mill equipped with roaster and magnetic separator, each made a good output of zinc blende concentrates. The Earl Lead and Zinc Company, operating several miles southwest of Mineral Point, completed a 50-ton mill late in the year and made a short run. The Merry Christmas Lead and Zinc Mining Company began the construction of a 50-ton mill, which was completed late in the year, but not operated. The Harris Mining Company began to sink an inclined shaft and to erect a mill.

Platteville district.—The Acme Mining Company completed a 100-ton mill in August and a 30-ton roaster and magnetic separator in December. A good production of zinc concentrates was reported. The Big Jack Mining Company was reorganized in October, becoming the W.-M. Mining Company. It is equipped with a 200-ton concentrating plant, and made a fair output of lead and zinc concentrates. The Enterprise mill of the Platteville Lead and Zinc Company was overhauled and new jigs were installed. The mill has a capacity of 50 tons, and is equipped with concentrating tables and a roaster and magnetic separator. The company reported a good production of lead and zinc concentrates. The Grant County Mining Company erected a 75-ton mill and made a fair production of zinc concentrates. The Hodge Zinc Mining Company completed a concentrating plant of 75 tons capacity in October, and made a good output of zinc concentrates. After milling the iron is separated at a neighboring roasting and separating plant. The Hibernian Mining Company completed a new 100-ton mill in May, and made a small output of zinc concentrates before closing down. The mill was later sold under foreclosure and the mine abandoned. The Klar-Piquette Mining Company, bought the Phœnix 50-ton mill, installed it at the mine, and began shipping ore in June. A good production of zinc concentrates was reported. The Platte Zinc Mining Company was engaged in prospecting during 1907. The mine has a complete concentrating plant equipped with 5 jigs. The Royal Zinc Mining Company completed a concentrating plant in October, and made a good production of high-grade zinc concentrates. The mill has a capacity of 100-tons, and is equipped with roaster and magnetic separator. The St. Rose Mining Company made a good production of zinc concentrates.. The Graham & Stevens mine made a fair production of high-grade zinc concentrates. The mine is equipped with a 50-ton mill and is operated by a day level or tunnel. The Weigel Mining Company erected a 60-ton concentrating plant which was finished in December, but was not operated. The Empire Mining Company operating a 100-ton mill with roasting equipment made a large production.

Potosi district.—The Grant Mining and Lumber Company, the Potosi Mining and Milling Company, the Dutch Hollow Lead and Zinc Mining Company, and the Horseshoe Zinc Company are prospecting and developing properties in the vicinity of Potosi. The Preston Point Mining and Milling Company completed a 90-ton mill, which made a short run. The Little Horseshoe mine produced considerable lead ore from a depth of 150 feet. The King Solomon Mining Company and the Wisconsin Metal Company, operating in Pennakamp Bluff, are driving tunnels into the hill.

Other districts.—The Big Four Mining Company, in the Buncombe district, began the erection of an 80-ton mill, which was not finished at the close of the year. The lease of the Rowley Mining Company, on the Gillette tract at Buncombe station, was forfeited. The O. P. David Mining Company, operating at Montfort, completed a 75-ton mill in March and operated actively until October, when operations stopped on account of the low price of ore. The Brown Croft Mining Company, of Shullsburg, made a fair production of zinc-blende concentrates. The mine is worked by an inclined shaft, and is equipped with a 50-ton concentrating plant, roaster, and magnetic separator.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN STATES.

(MINE PRODUCTION.)

By H. D. McCaskey.

INTRODUCTION.

This report is a statement and review of the production of the gold, silver, copper, lead, and zinc mines of the Eastern or Appalachian States for 1907, and includes Alabama, Georgia, New Hampshire, New Jersey, North Carolina, South Carolina, Tennessee, Vermont, and Virginia, all of which produced one or more of these metals during the year. The territory thus covered is for the greater part coincident with the broad belt of old metamorphic and associated igneous rocks extending southwesterly from Vermont to Alabama. The zinc-lead belt of southwest Virginia, however, and its extension into East Tennessee, lies to the west of this great Appalachian belt, and is contained within the limestones and dolomites of Cambro-Ordovician time.

In addition to the mines of gold, copper, lead, and zinc ores which form the main consideration of this report, pyrite mines known to be actually producing copper ores are also taken into account, and the tonnage of chalcopyrite or cupriferous pyrite, producing copper and silver, is, for the purpose of the report, the tonnage of these mines.

The production given in the following tables is that reported by the mines to the United States Geological Survey and may differ in details from the figures of the refineries and of the United States Mint. The latter represent the actual production for the year of the metals in marketable form, whereas the figures of the mine reports represent the metals in the ore mined and sold or treated during the year in review. The agreement between the sets of figures is usually close.

PRODUCTION.

The total value of the production of gold, silver, copper, lead, and zinc in the Eastern States for the calendar year 1907 was $5,729,998. This output was from 105 producing mines, of which 59 were placers. The gold product was 11,605.26 fine ounces, valued at $239,902, and the yield of silver was 85,661 fine ounces, valued at $56,536. The total value of the precious metals amounted to $296,438, and as compared with that of 1906 showed an increase of $17, there being an increase in value of gold of $3,171, but a decrease in value of silver of $3,154. The falling off in silver production was directly due to the depressed condition of the copper market in the latter part of

1907 and the closing down of the chief copper mines of North Carolina. Of the gold, 1,660.77 fine ounces were obtained from placer mines, 9,425.85 fine ounces from quartz mines, and 518.64 fine ounces from copper mines. Of the silver, 109 fine ounces were obtained from placers, 1,211 fine ounces from quartz mines, 84,167 fine ounces from copper mines, and 174 fine ounces from lead mines. Of ores producing the precious metals there were mined 60,634 short tons of dry or siliceous ores, with an average value of gold and silver of $3.21 per ton, and 617,865 short tons of copper ores, with an average value of $0.119 in precious metals to the ton. The 558,487 short tons of copper ore from the Ducktown mines, averaging only $0.072 to the ton, being omitted, there were 59,378 tons of copper ore mined, averaging $0.403 to the ton in silver and gold. In addition to the precious metals the Eastern States produced 20,307,180 pounds of copper, valued at $4,061,436; 140,599 pounds of lead, valued at $7,451, and 22,748,193 pounds of zinc, valued at $1,364,673. The copper production showed an increase in quantity of 1,457,575 pounds and in value of $404,161; and the lead production showed a corresponding increase of 130,849 pounds, valued at $6,895. The zinc production is reported for the first time and therefore can not be compared.

Following is a tabulated statement of the production of the Eastern States:

Production of gold, silver, and associated metals in Eastern States in 1906 and 1907.

	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1906	11,451.86	$236,731	89,088	$59,690	18,849,605	$3,657,275
1907	11,605.26	239,902	85,661	56,536	20,307,180	4,061,436
Increase (+) or decrease (−)	+153.40	+3,171	−3,427	−3,154	+1,457,575	+404,161

	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1906	9,750	$556	(a)	(a)	a$3,954,252
1907	140,599	7,451	22,748,193	$1,364,673	5,729,998
Increase (+) or decrease (−)	+130,849	+6,895	+22,748,193	+1,364,673	a+1,775,746

a No mine report in 1906 on zinc production.

The total tonnage from deep mines in 1907 was 906,103 short tons, yielding $5,695,595 in gold, silver, copper, lead, and zinc. This gives an average total value per ton of $6.29.

GOLD.

The gold production of the Eastern States in 1907 was 11,605.26 fine ounces, which, at the standard value per fine ounce, amounted to $239,902—an increase in value of $3,171 as compared with the production of 1906. The most notable increase in gold production in 1907 was from Georgia, to which State an increase of $33,758 is credited. This gain was the result in part of the activity of the Franklin mine. Three other States—Alabama, North Carolina, and

Vermont—each showed slight increases, that of the first being due to the continued operations of the Hog Mountain mines aided by a slight production of the Tallapoosa mine and of extraction of precious metals from copper obtained from the pyrite mines at Pyriton, and that of the last to increased activity in the Orange County copper mines. Decreases of production of gold were shown in all the other States of the South in 1907, and in some measure reflected the industrial conditions of the year. It is thought that the year 1908 will show a material increase in the gold production of the Southern States.

SILVER.

The production of silver in the Eastern States in 1907 was 85,661 fine ounces, valued at $56,536, the average value of silver per fine ounce in 1907 being 66 cents. A decrease in value of $3,154 was shown for the silver output as compared with that of 1906. This was caused chiefly by the low price of copper and the decreased production of that metal in the latter part of 1907 in North Carolina, as the greater part of the silver product of the Appalachians is recovered from copper ores. On the other hand, all of the other States showed slight increases, due partly to increased copper mining at the prevailing good prices in the earlier part of the year and partly to the increased output of gold. Comparatively little silver was recovered from lead ores in 1907, and no ores rich enough in silver to be classified as silver ores have been mined for many years.

Production of gold and silver in Eastern States in 1907, by States, in fine ounces.

State.	Gold.		Silver.		Total value.	Increase (+) or decrease (−) in value compared with 1906.	
	Quantity.	Value.	Quantity.	Value.		Gold.	Silver.
Alabama	1,256.88	$25,982	439	$290	$26,272	+$1,061	+ $207
Georgia	3,135.09	64,808	864	570	65,378	+33,758	+ 168
New Hampshire			174	115	115		+ 115
North Carolina	3,976.08	82,193	21,667	14,300	96,493	+ 62	− 6,315
South Carolina	2,649.26	54,765	124	82	54,847	−24,194	+ 20
Tennessee	185.04	3,825	58,358	38,516	42,341	− 1,013	+ 1,042
Virginia	400.93	8,288	221	146	8,434	− 6,544	− 22
Vermont	1.98	41	3,814	2,517	2,558	+ 41	+[a] 1,631
Total	11,605.26	239,902	85,661	56,536	296,438	+ 3,171	− 3,154

[a] Vermont produced $886 in silver in 1906.

Source of gold and silver in Eastern States in 1907, by States, in fine ounces.

State.	Gold.			Silver.			
	Placers.	Dry or siliceous ores.	Copper ores.	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.
Alabama	2.03	1,232.35	22.50		189	250	
Georgia	1,132.61	1,918.50	83.98	52	32	780	
New Hampshire							174
North Carolina	475.72	3,275.27	225.09	53	722	20,892	
South Carolina	44.75	2,604.51		4	120		
Tennessee			185.04			58,358	
Virginia	5.66	395.22	.05		148	73	
Vermont			1.98			3,814	
Total	1,660.77	9,425.85	518.64	109	1,211	84,167	174

Number of producing mines, ore production, and average value of gold and silver per ton in Eastern States in 1907, by States, in short tons.

State.	Number of mines.			Ore production from deep mines and average value in gold and silver per short ton mined.								
					Dry or siliceous ores.		Copper ores.		Lead ores.		Zinc ores.	
	Placer.	Deep.	Total.	Total production.	Quantity.	Average value.	Quantity.	Average value.	Quantity.	Average value.	Quantity.	Average value.
Alabama, Georgia, and Maryland	27	13	40	25,627	14,887	$4.385	10,740	$0.269	......	......	......	......
New Jersey	....	1	1	223,621	......	......	......	......	......	......	223,621	......
North Carolina	26	17	43	19,682	8,421	8.09	11,261	1.64	......	......	......	......
South Carolina	5	1	6	36,198	36,198	1.49	......	......	......	......	......	......
Tennessee	....	4	4	561,805	......	......	558,487	.072	......	......	3,318	......
Virginia	1	7	8	26,837	1,128	7.33	25,044	.002	[a] 665	$0.444	......	......
Vermont	....	3	3	12,333	......	......	12,333	.313	......	......	......	......
Total	59	46	105	906,103	60,634	3.21	617,865	.119	665	.444	226,939	......

[a] Includes lead ore of New Hampshire

COPPER.

The copper production of the Eastern States in 1907 amounted to 20,307,180 pounds, valued at the average price for the year of 20 cents per pound at $4,061,436. This production was, as usual, chiefly from the famous Ducktown mines of Tennessee; but Alabama, Georgia, Maryland, North Carolina, Vermont, and Virginia all contributed, North Carolina and Vermont each producing over 500,000 pounds. The total production of the Eastern States showed an increase of 1,457,575 pounds of copper, valued at $404,161, as compared with the output of 1906. This increase was caused both by better prices at the beginning of the year and by the reopening of the well-known mines of Orange County, Vt. On the other hand, the production of the mines of Gold Hill, N. C., was greatly curtailed by the closing down of work during the period of depression at the end of 1907. The copper ores of the Eastern States yielded an average of 32.9 pounds of copper to the ton. There seems to be considerable promise of increased copper production from these States, particularly from the Virgilina field in Virginia and North Carolina, from Vermont, and from large pyrite deposits containing copper. This copper from pyrite mines has been neglected to a large extent in the past.

LEAD.

The lead production of the Eastern States in 1907 amounted to 140,599 pounds, valued at $7,451, the average value for the metal during the year being 5.3 cents per pound. The lead ores yielded an average of 189.8 pounds of metal to the ton. This production came from New Hampshire, Georgia, and Virginia, the latter furnishing the bulk of the production. There seems little likelihood of an important supply of this metal from these States in the future, although the production of 1907 represented an increase of 130,849 pounds, valued at $6,895, as compared with the output of 1906.

ZINC.

During 1907 the spelter production of the Eastern States, as reported from the producing mines, amounted to 22,748,193 pounds, valued at $1,364,673. The average price of spelter for the year was 5.9 cents per pound. The zinc ores yielded an average of 100.2 pounds of metal to the ton. As figures for the production of this metal were not obtained from the mines in 1906, comparisons can not be made. The great bulk of the zinc production was from the famous mines at Franklin in New Jersey, which continued their important yearly contribution of this metal to the world's supply. The southwestern extension into Tennessee of the Virginia zinc belt, however, was vigorously prospected and developed during the year, and production was reported from a number of mines.

Production of copper, lead, and zinc in Eastern States in 1907, by States, in pounds.

State.	Copper.		Lead.		Zinc	
	Quantity.	Value	Quantity.	Value.	Quantity.	Value.
Alabama, Georgia, and Maryland	122,678	$24,536				
New Hampshire			[a] 140,599	$7,451		
New Jersey					22,529,550	$1,351,773
North Carolina	582,082	116,416				
Tennessee	18,893,115	3,778,623			218,643	12,900
Virginia	58,880	11,776				
Vermont	650,425	130,085				
Total	20,307,180	4,061,436	140,599	7,451	22,748,193	1,364,673

[a] Includes lead production of Georgia and Virginia.

Number of copper, lead, and zinc producing mines, ore tonnage, and average pounds of metal recovered per short ton of ore in Eastern States in 1907, by States.

State.	Number of mines.			Copper ore.		Lead ore.		Zinc ore.	
	Copper.	Lead.	Zinc.	Quantity.	Average per ton of ore.	Quantity.	Average per ton of ore.	Quantity.	Average per ton of ore.
				Short tons.	*Pounds.*	*Short tons.*	*Pounds.*	*Short tons.*	*Pounds.*
Alabama, Georgia, and Maryland	3			10,740	11.5				
New Jersey			1					223,621	100.7
North Carolina	7			11,261	51.7				
Tennessee	2		2	558,487	33.8			3,318	61.3
Virginia	4	2		25,044	2.3	[a] 665	[a] 189.8		
Vermont	3			12,333	52.7				
Total	19	2	3	617,865	32.9	665	189.8	226,939	100.2

[a] Includes lead production of New Hampshire.

PROGRESS OF THE MINING INDUSTRY DURING THE YEAR.

During 1907, as compared with conditions of the preceding year, there was a general increase of mining activity in the Eastern States. This was shown in the resumption of work upon previous producing mines that had closed down, as in the copper mines of Vermont and the zinc mines of Tennessee, and in a greater amount of prospecting and development work. In Alabama the work of the Gold Ridge

Mining Company was new; in Georgia there was a notable increase in production; and in North Carolina conditions remained as active as in 1906 until the depression of the fall, when the Union mines suspended work, as did the Seminole mine of Georgia. The two most productive gold mines of the South, the Haile, of South Carolina, and the Iola, of North Carolina, continued their operations uninterruptedly throughout the year. The third gold mine, in order of production, the Franklin, of Georgia, greatly increased its output and reported plans for still more active operations. In Tennessee there was increased production at Ducktown and new work in the zinc deposits, but the gold placers of Monroe County produced nothing. In Virginia interest in the Virgilina field and steady production of pyrites were notable. Toward the close of the year the low state of the copper market and the generally depressed industrial conditions tended somewhat to lower the record of an unusually prosperous year.

PRODUCTION BY STATES.

ALABAMA.

Production of gold and silver in Alabama in 1906 and 1907, in fine ounces.

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1906	1,205.55	$24,921	124	$83	$25,004
1907	1,256.88	25,982	439	290	26,272
Increase (+) or decrease (−)	+51.33	+1,061	+315	+207	+1,268

During 1907 Alabama produced gold and silver to the value of $26,272, an increase over the production of these metals in 1906 of $1,268. The gold yield was 1,256.88 fine ounces, valued at $25,982—an increase in quantity of 51.33 fine ounces and in value of $1,061. The silver yield, always small, was 439 fine ounces, valued at $290. Alabama also produced some copper in the form of cement recovered from treatment in acid works of the cupriferous pyrite ores of Pyriton, in Clay County. The copper production of Alabama came from a single producer in 1907, and in order to protect individual returns the figures have been combined with those of Georgia and Maryland, which also report but a single producer each.

The gold belt of the Appalachian States terminates in the east-central portion of Alabama and includes parts or all of Cleburne, Randolph, Clay, Talladega, Tallapoosa, Coosa, Chilton, and Elmore counties. The area involved is roughly that of an equilateral triangle, with one side lying along the middle third of the Alabama-Georgia line, and is about 4,000 square miles in extent. The geological relations have previously been briefly described by Phillips,[a] Smith,[b] McCaskey,[c] and other writers who have studied them in the field.

The rocks within this area include the "Talladega" or Ocoee metamorphic rocks, chiefly slates and sandstones, and probably of

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[a] Phillips, W. B., A preliminary report on a part of the lower gold belt of Alabama: Bull. Geol. Survey Alabama No. 3, 1892.

[b] Brewer, W. M., Smith, E. A., Hawes, G. W., Clements, J. M., and Brooks, A. H., A preliminary report on the upper gold belt of Alabama, with supplementary notes on the most important varieties of metamorphic or crystalline rocks of Alabama: Bull. Geol. Survey Alabama No. 5, 1896.

[c] McCaskey, H. D., Notes on some gold deposits of Alabama: Bull. U. S. Geol. Survey No. 340, 1908.

Cambrian age; a smaller area of later slates, probably Devonian or early Carboniferous, lying along the northwestern border of Clay County; gneisses and schists, probably pre-Cambrian; and intrusive granites and greenstones. Three fairly well defined belts of the "Talladega" slates, which are provisionally correlated with the Ocoee, occur within this area, striking northeast and southwest and dipping rather steeply to the southeast. Within these belts and along their borders with the more highly crystalline granites and gneisses occur most of the gold and pyrite deposits. The Hog Mountain fissure veins, however, are in granite, and some of the lenticular veins are in gneiss.

The year 1907 was marked by the continuation of active development, of experiments with metallurgical methods best adapted to the ores, and of steady production at the Hog Mountain mines; by renewed interest in the old Silver Hill mines and in the Tallapoosa mine, with slight production from the latter during the early part of the year; by operations at Clear Creek and development at Gold Ridge; and by the continued output of cupriferous pyrite ore of the Pyriton mines.

In Clay County the pyrite mines of the Southern Sulphur Ore Company, at Pyriton, produced a considerable tonnage which was sold to sulphuric acid plants and from which some copper, silver, and gold were obtained. The shaft at this mine is 350 feet deep. In Cleburne County the Gold Ridge Mining Company carried on experiments in the placers of Clear Creek near Arbacoochee. A hydraulic elevator, giants, and sluice boxes were installed toward the close of the year, and an extensive campaign was planned for 1908. There was no reported production from this county for the year. In Randolph County this same company was actively developing its properties at Gold Ridge, in the northeastern portion of the county, during the last few months of the year. Underground work included an inclined shaft down 100 feet on the vein and levels to the extent of 250 feet. The ores, so far as developed above water level, are siliceous and oxidized iron pyrites ores. They are largely free milling, and a steam 2-stamp mill was installed to treat them in an experimental way. No production was reported for the year. In Tallapoosa County the famous old Silver Hill deposits were reopened for examination, but nothing further was done upon them. The Tallapoosa mine furnished a small production in the early part of the year and was then closed down pending a reexamination of this property that was being made during the closing months of the year. The Hog Mountain mines, of the Hillabee Mining Company, near Yates, were actively developed and furnished the greater part of the production of the State in 1907, as they had done in the last preceding years. The ore deposits at this mine have recently been briefly described.[a] The hill has been pretty thoroughly prospected by crosscuts and open cuts, and considerable ore has been developed. The Blue vein and the Barren vein were worked in 1907 by a well-equipped vertical shaft 100 feet deep and by 300 feet of levels and crosscuts. The ores treated are partly oxidized, partly sulphides. The process in 1907 was dry crushing between two sets of rolls and treatment in a revolving kiln to 350° F., followed by cyanide leaching in a 75-ton plant. A tube mill was run for fine grinding in the early part of the year, but was later abandoned for coarse crushing alone. The process used was working fairly well with mixed oxidized and sulphide ores, but efforts were continued to complete systematic experimentation until the treatment of highest efficiency could be worked out.

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[a] McCaskey, H. D., Notes on some gold deposits of Alabama: Bull. U. S. Geol. Survey No. 340, 1908, pp. 39-41.

GEORGIA.

Production of gold and silver in Georgia in 1906 and 1907, in fine ounces.

Year.	Gold.		Silver.		Total.
	Quantity.	Value.	Quantity.	Value.	
1906	1,502.05	$31,050	599	$402	$31,452
1907	3,135.09	64,808	864	570	65,378
Increase (+) or decrease (−)	+1,633.04	+33,758	+265	+168	+33,926

The production of precious metals in Georgia in 1907 amounted in value to $65,378, an increase over the production of 1906 of $33,926. Of gold there was a production of 3,135.09 fine ounces, valued at $64,808, and of silver there were 864 fine ounces, valued, at the average price of silver for the year, at $570. There was thus an increase in gold of 1,633.04 fine ounces, valued at $33,758, and in silver of 265 fine ounces, valued at $168. This is an increased production of over 100 per cent both of the gold and of the total silver and gold as compared with the output of 1906. Georgia produced copper and lead also, the former showing a slight decrease, the latter an increase, over the production for 1906. The exact figures, as coming from single producers, can not be given, and they are, therefore, combined with those of other States, as shown in the tables. During the year there were 4,737 short tons of ore mined and treated from 9 deep mines. The total value of this ore in gold, silver, lead, and copper was $40,640. The production of copper, silver, and lead was curtailed in Georgia, as elsewhere, in the latter part of 1907. There was considerable increase of gold, both in development and in production, from placer mining during the year. On the whole, Georgia took second rank among the Appalachian States in the value of production of precious metals for 1907, and fifth rank in total value of production of gold, silver, copper, lead, and zinc.

As noted in the report for 1906,[a] the Appalachian gold belt crosses the northwestern portion of Georgia and includes parts or all of Carroll, Cherokee, Cobb, Fannin, Forsyth, Hall, Haralson, Lincoln, Lumpkin, McDuffie, Murray, Towns, Union, White, and Wilkes counties. The best defined belt within this area extends from southwest to northeast from Alabama to North Carolina and includes most of the gold, copper, and pyrite mines of Haralson, Paulding, Cobb, Cherokee, Forsyth, Dawson, Lumpkin, and White counties. This has well been called the "Dahlonega Gold Belt,"[b] as the important deposits of this district are within the broadest portion of the belt. The rocks associated with the Appalachian gold belt in Georgia, as generally elsewhere, consist largely of metamorphosed igneous and sedimentary rocks of Cambrian or earlier age, intruded by granites and later by diabase. The ore deposits lie in the eastern ranges of the Blue Ridge and in the Piedmont Plateau. To the northwest of the gold belt occur Paleozoic rocks, including the beautiful Georgia marbles, and to the southeast are the younger formations of the Coastal Plain.

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[a] Mineral Resources U. S. for 1906, U. S. Geol. Survey, 1907, p. 327.

[b] Yates, W. S., and others, A preliminary report on a part of the gold deposits of Georgia: Bull. Geol. Survey Georgia No. 4—A, 1896, p. 33.

Production of gold and silver in Georgia in 1907, by counties, in fine ounces.

County.	Gold.		Sliver.		Total value.
	Quantity	Value.	Quantity.	Value.	
Cherokee, Cobb, and Forsyth	1,438.62	$29,739	27	$18	$29,757
Lincoln and McDuffie	500.68	10,350	780	515	10,865
Lumpkin	583.31	12,058	29	19	12,077
White	542.24	11,209	19	13	11,222
Other counties	70.24	1,452	9	5	1,457
Total	3,135.09	64,808	864	570	65,378

In Cherokee County the Franklin (Creighton) mine of the Franklin Gold, Pyrite, and Power Development Company has materially increased its output of gold and silver over that of 1906. Shafts Nos. 1, 2, and 3 were not worked during the year, but the ore bodies worked from shaft No. 3½ were actively developed down to 420 feet; the No. 4 inclined shaft was driven to 900 feet, and there was considerable prospecting by shafts, tunnels, and open cuts to explore fully the undeveloped territory. Some of the most promising veins of this property have not yet been touched, owing to the limited water power and milling capacity at present available. The company controls important resources for water power on the Etowah River, and with development of this and extension of plant, as at present planned, the Franklin mine would seem to promise an important output. As it is, this has been one of the most successful mines of the South and a vindication of the value of competent management applied to ore deposits of average grade which require chiefly sufficient engineering and metallurgical skill and sufficient capital to develop them into important producing mines. The siliceous sulphide ore is at present treated in a mill containing ten 850-pound stamps, with plate amalgamation and Frue vanners. The concentrates are roasted in a 4-ton roasting plant, and the final treatment is barrel chlorination. Copper and pyrite deposits are also found on the property of this company, but are not worked for lack of water power. The Blake pyrite mine, to the southwest of the Franklin mine and within the same important gold-copper-pyrite belt, produced cupriferous pyrite during the year, which was sold to sulphuric-acid plants for its sulphur value only. Cherokee County reported a small placer production, as did Cobb, Forsyth, and Greene counties.

In Lincoln County the Seminole mine produced gold, silver, copper, and lead, the output being about the same as that of 1906. Had the mine not been closed during the industrial depression of the latter part of the year, the production would probably have shown a material increase. The plant at this mine consists of a 40-ton concentration plant, a reverberatory roasting furnace, and a 15-ton blast furnace.

Lumpkin County lies midway in the most important gold belt of Georgia, which extends to the northeast from Alabama through Haralson, Paulding, Cobb, Cherokee, Lawson, Lumpkin, White, and

Rabun counties. As is well known, this county has produced much gold and was at one time the home of a United States assay office. The original output was from the surface workings of the weathered auriferous rock in place, as well as from ordinary stream placers, and the greater part of the output to-day is still from these sources. The deep mines and reduction plants have so far produced but little gold, owing to various causes for which many conflicting reasons are given. There seems every probability that there are important ore bodies available in depth in this region, particularly in the Dahlonega district, but unfortunate methods have largely prevented their active development. It is sincerely to be hoped that well-directed effort will operate to bring to the mines of this county the productive importance they apparently deserve. On the Chestatee River the Dahlonega Gold Mining and Milling Company has actively prospected and developed its various properties. The placers have been operated by hydraulic method and by dredging, and the Briar Patch and Calhoun mines have been prospected by open cuts and shafts, developing some rich ore shoots near the surface. This company has been a producer during the year. The Water Power and Mining Company produced some gold and silver from the Barlow cut, and a number of other producers reported small amounts of placer gold from the Dahlonega district.

The Lockhart mine and the Singleton mine of the Standard group were both under lease and producing gold at the close of the year. The old vein of the Lockhart has developed some very large ore shoots said to average about $3 to the ton in gold. Above this a new vein containing a narrow streak of good ore has recently been prospected. The Lockhart mill consists of 20 stamps of 450 pounds each, 10 of which were in operation at the close of the year. Amalgamation was by apron plates only. The mill is also equipped with Wilfley tables, which have produced concentrates containing up to $39 in gold from ore varying between $3 and $9 to the ton. The shaft of this mine was 84 feet deep. A Cornish pump drained the mine. Water power was used for milling and pumping. The Singleton mine was worked by the "Dahlonega" method of breaking and sluicing down weathered vein material by hydraulic giants, followed by stamp milling. This method, inexpensive and in some cases profitable, was reported a signal failure in the case of the great Consolidated mill, as the surface material available in this case was found to be lower in value than the cost of operation. As ore from underground was not available, the splendid plant of the Consolidated mill has been closed down ever since the "Dahlonega" method failed. The mill of the Standard Gold Mining Company treating ore of this Singleton mine consists of ten 450-pound stamps and ten 550-pound stamps, with amalgamation on apron plates only and concentration on two Wilfley tables. The concentrates were roasted and chlorinated at the Consolidated plant while the latter was in operation. Mining operations on the Crown Mountain properties were suspended during the repair of the dam of the power plant on the Yahoola River. The Jumbo mine reported no production during the year. From rich ores of the Garnet and Dry Hollow mines there was a small production of gold in 1907. At Auraria, 6 miles south of Dahlonega, there was considerable activity and some production during the year. The inclined shaft of the Battle Branch mine was sunk to a depth of 125 feet and a tunnel was driven. The working incline of the Betz mine of the Piedmont Mining and Milling Company was extended to a depth of 425 feet. A mill, consisting of 10 stamps for preliminary crushing, two 5-foot Huntington mills for fine grinding and 2 Wilfley tables, has been erected, and this company, after extensive development, was expecting important production in 1908. The total production of Lumpkin County for 1907, although insignificant in comparison with its apparent resources, was $12,077, of which $12,058 was gold, $9,434 being placer gold. This shows an increase of $1,606 over the output of 1906.

In McDuffie County the Columbia mines have been developed by a 450-foot inclined shaft and a 500-foot tunnel. The mill is equipped with 10 stamps, and crushing is followed by plate amalgamation and concentration on Wilfley tables. Development underground and experiments with extraction processes have preceded production, although the output of gold and silver was important in 1907.

In White County a number of placer producers contributed to the output of gold, chief among which were the Blow dredge at Nacoochee and the Canadian-American Loud mines. The latter company has expended large sums on development work on its placers near Cleveland, and its work was chiefly preparatory to production in 1908. The total production of gold and silver in White County in 1907, all of placer origin, amounted to $11,222, as against $10,131 in 1906.

MARYLAND.

Maryland produced no gold or silver in 1907. From the Liberty mine, near Union Bridge, of the Virginia Consolidated Copper Company, shipments of copper concentrates were made during the year. The production is combined with the copper output of Alabama and Georgia to protect individual figures. Construction was begun at this mine upon a modern 150-ton concentration plant designed to treat the bornite, chalcocite, and chalcopyrite ores reported here, and a modern 3-compartment vertical shaft was being sunk in 1907 to develop sufficient underground reserves.

MASSACHUSETTS.

In Franklin County, Mass., are the Davis and Davenport pyrite mines, whose ores carry small percentages of copper, of which metal they may become producers as a by-product of the manufacture of sulphuric acid, or from sorting, concentration, and shipment to smelters of the more highly cupriferous ores. This recovery of copper may also be made from other similar pyrite deposits of the Appalachian States under favorable market conditions, and is now made in one or two instances. Some copper matte was produced at the Davenport mine but not marketed. No production is reported for this State in 1907.

NEW HAMPSHIRE.

In Carroll, Coos, and Grafton counties, of New Hampshire, are a number of old mines whose ores are mainly sulphides of copper, lead, zinc, and iron, with small amounts of the precious metals. Among these is the Gorham mine, which reported a small production of silver and lead during 1907.

NEW JERSEY.

New Jersey reported no production of copper, lead, or the precious metals in 1907. The mines of the New Jersey Zinc Company, however, at Franklin Furnace, continued their important yearly output of spelter and contributed largely to the world's supply. These mines are worked both by open cut and by shafts and levels, and the ores are about one-half franklinite, one-third willemite, and the remainder chiefly calcite. The main ore body is of unusual form, resembling a deep and narrow scoop, and its genesis is a problem of exceptional interest. An important contribution on the subject may be expected shortly from the Survey in the form of the Franklin Furnace folio of the Geological Atlas of the United States.

NORTH CAROLINA.

Production of gold, silver, and copper in North Carolina in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		
1906	3,973.09	$82,131	30,769	$20,615	703,775	$135,829	$238,575
1907	3,976.08	82,193	21,667	14,300	582,082	116,416	212,909
Increase (+) or decrease (−)	+2.999	+62	−9,102	−6,315	−121,693	−19,413	−25,666

In 1907 the total production of gold and silver in North Carolina was valued at $96,493. This represents a decrease in value, as compared with the production in 1906, of $6,253. There were 3,976.08 fine ounces of gold, valued at $82,193, and 21,667 fine ounces of silver, valued at $14,300, reported for 1907. These represent an increase of 3 fine ounces of gold, valued at $62, and a decrease of 9,102 fine ounces of silver, valued at $6,315, as compared with the output for 1906. In addition to the precious metals North Carolina produced 582,082 pounds of copper in 1907, valued at $116,416—a decrease, as compared with the production of 1906, of 121,693 pounds in quantity and of $19,413 in value. The total value of the production of gold, silver, and copper in this State was, therefore, $212,909, or $25,666 less than in 1906. The greatest decrease was in copper, the decline in production of which directly affected also the total value of the production of silver, and to a less degree that of gold. The gold mines of North Carolina just held their own during the year. The decrease in copper was due largely to reduced prices for this metal in the latter part of 1907.

North Carolina maintained first place among the gold and silver producing States of the Appalachians, with Georgia as chief competitor. Georgia passed South Carolina in 1907 and, at the rate of increase and decrease established, may wrest first place from North Carolina in the near future. North Carolina lost second rank in the production of copper to Vermont.

The production of North Carolina was from 26 placer mines and 17 deep mines, an increase of 17 placers and of 2 deep mines as compared with 1906. The total tonnage raised from the deep mines during the year was 19,682, of which 8,421 tons were from dry or siliceous ores carrying average values in gold and silver of $8.09 to the ton, and the remaining 11,261 tons were of copper ores carrying average values of $1.64 to the ton in gold and silver and 2.58 per cent of copper.

The ore deposits of North Carolina may be fairly well grouped within five roughly parallel belts, as outlined by Nitze[a] some years ago, who described: (1) The eastern belt of metamorphic rocks in Nash, Franklin, and Halifax counties, and lying between the Coastal Plain sediments on the east and the granites and other igneous rocks on the west; (2) the Carolina slate belt of crystalline schists and slates in Granville, Person, Alamance, Orange, Chatham, Randolph, Davidson, Montgomery, Rowan, Cabarrus, Stanly, and Union counties bordered on the east by Triassic rocks and on the west by rocks of the following division; (3) the North Carolina igneous belt, chiefly of granites and diorites, in Guilford, Davidson, Rowan, Cabarrus, and Mecklenburg counties; (4) the Kings Mountain belt of gneisses, schists, and quartzites, in Gaston, Lincoln, Catawba, Davie, and Yadkin counties; and (5) the South Mountain belt of schists, gneisses, and granitic rocks, in Burke, McDowell, Rutherford and Polk counties. These belts are given in order from east to west and lie for the greater part in the Piedmont Plateau.

Production of gold, silver, and copper in North Carolina in 1907, by counties.

County.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		
Burke	143.96	$2,976	20	$13			$2,989
Cabarrus	73.58	1,521	2	1			1,522
Catawba and Gaston	318 02	6,574	68	45			6,619
Davidson and Stanly	21.09	436	165	109	[a] 14,044	[a] 2,809	[a] 3,354
Franklin	57.37	1,186	3	2			1,188
Guilford	90.13	1,863					1,863
Granville and Person	14.03	290	6,746	4,453	286,021	57,204	61,947
McDowell and Rutherford	21.53	445	2	2			447
Mecklenburg	374.61	7,744					7,744
Montgomery	2,536 69	52,438	621	410			52,848
Moore	10.88	225	2	1			226
Randolph and Rowan	192.67	3 983	14,004	9,243	282,017	56,403	69,629
Union and others	121.52	2,512	33	21			2,533
Total	3,976.08	82,193	21,666	14,300	582,082	116,416	212,909

[a] Includes copper of Guilford County.

Burke and Cabarrus counties each reported small amounts of placer gold in 1907. In Catawba County the Catawba Gold Mining Company produced some gold during test runs and did a great deal of exploratory and development work. The company proposes the erection of a plant in 1908 capable of handling 2,000 tons of material per day. In Davidson County the Hercules Gold and Copper Company, working the Emmons mine, produced gold, silver, and copper in 1907. This mine is developed by 2 inclined shafts on the same vein, 500 feet apart and 600 and 400 feet deep, respectively. The plant consists of a 10-stamp mill, with Blake crusher and Wilfley concentrators, and a 50-ton Allis-Chalmers copper blast furnace. No ore was smelted in 1907, the crude ore and concentrates being shipped to smelters. In Franklin County there was a slight production of placer gold during the year.

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[a] Nitze, H. B. C., Gold Deposits of North Carolina: Bull. North Carolina Geological Survey No. 3, 1896.

In Granville County the Blue Wing and Copper King mines produced copper, silver, and gold. These mines lie in the important Virgilina belt, which crosses the Virginia-North Carolina line from Halifax County, Va., on the north through the northwestern corner of Granville County, N. C., into Person County on the south. The Blue Wing mine is opened by an inclined shaft on the foot wall of the vein, which dips about 70° to the east. The plant at the mine consists of a crusher and a Robins picking belt for hand sorting. The highly siliceous chalcocite and bornite ores are crushed and sorted, and the higher grade ore is shipped to the Eustis smelter at West Norfolk, Va.

In Gaston County the Kings Mountain mine was not worked, but there was some production of gold and silver resulting from operations on the old ore dump. In Guilford County the Fentress mine of the Century Development Company mined a small quantity of ore, which was treated in the 10-stamp plate-amalgamation mill, the concentrates being shipped to smelters. The Hodson mine, near High Point, operated through the Deep River shaft, also had a small output of silver and gold. This mine is developed by 7 shafts from 30 feet to 210 feet deep, and the plant is equipped with a mill of ten 450-pound stamps and a Wilfley concentrator. There was a small production of placer gold from this county during 1907 and also from McDowell County. In Mecklenburg County several shipments of rich gold ore were made to smelters from the Rudisil mine, near Charlotte. There was also a small production of placer gold in this county from the Surface Hill, Means, and other mines, and from the Catawba River dredge. Montgomery County reported a slight placer production in 1907. The chief gold and silver production from this county, however, was, as usual, from the Iola mine. This is the largest producer of the precious metals in North Carolina, and, next to the Haile mine of South Carolina, the largest in all the Appalachian States. The Iola mine is developed by a 400-foot vertical shaft and a 150-foot incline. The ores are treated in a 40-stamp mill and a cyanide plant.

In Moore County the Elise Mining Company, operating open cuts near Hemp, treated a small amount of weathered surface material in place in a washing machine and recovered some gold. Ordinary placers also reported small amounts of gold. In Person County the well-known Durgy (Yancey) mine, at the southern end of the Virgilina belt, was operated during the early part of the year and produced copper, silver, and gold. This mine is equipped with a 200-ton mill for crushing and concentrating the ores. The best practice at present on the Virgilina belt is apparently concentration and shipment, as the crude ore is too highly siliceous to be welcomed by many of the smelters.

In Randolph County small amounts of gold were obtained from several placers, and the Ashboro Copper Company produced some copper and silver from the Scarlett mine. Efforts to install a reduction plant at this mine in 1907 were checked by lack of funds during the financial depression of the year.

In Rowan County the Southern Mining Company produced small amounts of placer gold, and the Union mines of Gold Hill continued their important production of copper, silver, and gold, although the output was curtailed during the prevalence of low prices of copper in the latter part of the year. This mine is now 650 feet deep. The No. 3 shaft only was worked during the greater part of the year, but ore was taken out from the No. 7 and No. 11 shafts during part of the time. The crude ore from this mine was shipped to smelters in New Jersey in 1907. The Gold Hill mines also produced some gold and silver, but activity in 1907 was applied chiefly to development work. The mine is opened by a vertical shaft 830 feet deep and is equipped with a 40-stamp mill and 12 Wilfley concentrators. A part of the crude ore is shipped, the remainder is first treated at the mill, and the concentrates from it are shipped to smelters.

Ruth and Rutherford counties both produced small amounts of placer gold in 1907. The Parker mine in Stanly County is equipped with an Erdman concentrating and washing machine and produced some gold from the treatment of surface material. Ordinary placers also reported small production from this county in 1907.

Work at the Colossus mine, in Union County, was confined to development, which resulted in a small production of gold in 1907. In this county also the Winona Mining Company reported production from the Davis mine, and other producers reported small amounts from placer operations.

SOUTH CAROLINA.

Production of gold and silver in South Carolina, in 1906–7, in fine ounces.

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1906	3,819.64	$78,959	92	$62	$79,021
1907	2,649.26	54,765	124	82	54,847
Increase (+) or decrease (–)	–1,170.38	–24,194	+32	+20	–24,174

In 1907 South Carolina produced gold and silver to the value of $54,847. This shows a decrease, as compared with the output of 1906, of $24,174 The gold production in 1907 was 2,649.26 fine ounces, valued at $54,765, and the silver production was 124 fine ounces, valued at $82—a decrease, as compared with 1906, of 1,170.38 fine ounces of gold, valued at $24,194, and an increase of 32 fine ounces of silver, valued at $20. There was no production of copper, lead, or zinc from South Carolina during the year. The output of precious metals, almost exclusively of gold, was from 5 placers and 1 deep mine, as compared with 2 placers and 4 deep mines in 1906. Of the gold production, 44.75 fine ounces was from placers and 2,604.51 fine ounces were from dry or siliceous ores; of the silver, 4 fine ounces were from placers and 120 fine ounces came from dry or siliceous ores.

Although the ancient metamorphic schists and granites of the Appalachian gold belt cover the greater part of the northwestern third of South Carolina, the producing counties of this area are very few, including in 1907 only Abbeville, Cherokee, and Lancaster counties. Graton[a] has furnished some valuable recent data descriptive of the rocks of this portion of the State.

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[a] Graton, L. C., Reconnaissance of some gold and tin deposits of the Southern Appalachians, with notes on the Dahlonega mines by Waldemar Lindgren: Bull. U. S. Geol. Survey No. 293, 1906.

In Abbeville, Cherokee, and Lancaster counties there was a small production of placer gold in 1907. In Lancaster County, also, the Haile mine continued its successful career as the largest producer of gold in the Appalachian States. A total of 36,198 short tons of ore were treated during the year, yielding $53,919 in gold and silver. This shows the working at a profit of ores returning a total value of only $1.49 to the ton, and is a remarkable demonstration of skillful treatment of low-grade ores. The plant is equipped with a 60-ton plate-amalgamation mill and with concentrators and the Thies chlorination process.

TENNESSEE.

Production of gold, silver, copper, and zinc in Tennessee in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		
1906	234.04	$4,838	55,931	$37,474	17,979,317	$3,470,008	....	....	$3,512,320
1907	185.04	3,825	58,358	38,516	18,893,115	3,778,623	218,643	$12,900	3,833,864
Increase (+) or decrease (−).	−49.00	−1,013	+2,427	+1,042	+913,798	+308,615	+218,643	+12,900	+321,544

In 1907 the State of Tennessee produced 185.04 fine ounces of gold, valued at $3,825; 58,358 fine ounces of silver, valued at $38,516; 18,893,115 pounds of copper, valued at $3,778,623, and 218,643 pounds of zinc, valued at $12,900—a total production of precious metals valued at $42,341, and an increase of $29, as compared with the output of 1906. Gold decreased 49 fine ounces, valued at $1,013, which was more than offset by an increase in silver, corresponding to the increased copper production, of 2,427 fine ounces in quantity and of $1,042 in value. The loss in gold was due to decrease in placer production in Monroe County. A large quantity of casting copper was shipped abroad unrefined, from which no gold or silver production could be reported. The estimated value of gold and silver in the copper ores is therefore undoubtedly low. During 1907 the copper production of Tennessee, all from the Ducktown district, increased 913,798 pounds in quantity and $308,615 in value over that of 1906. Tennessee also had an important output of zinc, as given above, from prospects and mines along the extension into the Knox dolomites of this State of the Virginia zinc-lead belt. The value of the total production of Tennessee in 1907 of gold, silver, copper, and zinc was $3,833,864, an increase, as compared with the production of 1906, of $321,544.

During 1907 there was no reported placer production of gold and silver. There were 4 producing deep mines, 2 of copper ores and 2 of zinc ores. From copper mines 558,487 short tons of ore were raised, and from zinc mines 3,318 short tons. From the copper ores there was reported an extraction of 185.04 fine ounces of gold and 58,358 fine ounces of silver. This shows an average value of precious metals recovered from copper ores of $0.07 per ton. The zinc ores yielded no silver or gold. The copper ores yielded an average per ton of 33.8 pounds of metal and the zinc ores an average of 61.3 pounds of metal. Tennessee easily retained first place in copper production of the Appalachian States.

The Ducktown district in Polk County is to be credited with all of the copper, silver, and gold produced in Tennessee in 1907. This production came from the Mary, Calloway, and East Tennessee mines of the Ducktown Sulphur, Copper, and Iron Company (Limited), and the Polk County, Burra Burra, and London mines of the Tennessee Copper Company. The working shafts of these mines are at present of the following depths: Mary mine, 550 feet; East Tennessee mine, 600 feet; Calloway mine, 345 feet; Polk County mine, 285 feet; Burra Burra mine, 713 and 288 feet; and the London mine, 588 feet. The mines of the Ducktown company are equipped with a 500-ton smelter, and the ore of the Tennessee Copper Company is pyritically smelted in a 1,600-ton smelter with converting plant. Bessemer copper from the latter is exported to Europe.

There was some prospecting of the Coker Creek placers of Monroe County, but no production was reported for 1907. In Jefferson County the old Wooten and Lay zinc mines near Newmarket were acquired by the Newmarket Zinc Company, which reported a considerable production of concentrates of carbonates and silicates of zinc from work during eight months of the year. The mines were worked by open cuts and shafts, and the ores were concentrated by means of log washers and jigs. The concentrates were shipped to the Bertha Mineral Company at Pulaski, Va. In Knox County the Holston Zinc Company worked their mines near Mascot toward the end of the year and produced some concentrates which were shipped to East St. Louis. The mines are developed by a vertical shaft 80 feet deep and by 250 feet of levels, and are equipped with a 150-ton crushing and concentrating plant. In this locality also the Roseberry mine, of the Roseberry Zinc Company, was developed by a vertical shaft 200 feet deep and was prospected by drills. There was an old 100-ton mill of the Joplin style on this property which has been dismantled preparatory to the erection of a modern mill. In Washington County, near Fall Branch, the East Tennessee Mining and Development Company has developed its mine by a shaft 70 feet deep and a tunnel 160 feet long, and was erecting a 100-ton concentrating mill early in 1908.

The problems of successful zinc mining in Tennessee have been somewhat serious, as in Virginia in the northeastern extension of this belt; but renewed and deeper prospecting and the readjustment of milling processes gave a hopeful turn toward the close of 1907 to the immediate future of the zinc industry in Tennessee.

VERMONT.

Production of gold, silver, and copper in Vermont in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		
1906			1,323	$886	240,315	$46,381	$47,267
1907	1.98	$41	3,814	2,517	650,425	130,085	132,643
Increase (+) or decrease (−)	+1.98	+41	+2,491	+1,631	+410,110	+83,704	+85,376

In 1907 Vermont produced copper, silver, and gold to the value of $132,643. This was from copper ores alone, as was the case of the production in 1906, and the total increase in value, as compared with

1906, was $85,376. The production of gold in 1907 was 1.98 fine ounces, valued at $41, showing increases by these amounts, as no gold was reported to be recovered from the copper ores in 1906. The silver production was 3,814 fine ounces, valued at $2,517, showing an increase of 2,491 fine ounces and of $1,631 as compared with the production of 1906. Of copper 650,425 pounds were produced, valued at $130,085—an increase, as compared with the production of 1906, of 410,110 pounds and of $83,704. Three deep mines reported production of copper, silver, and gold in Vermont in 1907, from 12,333 short tons of ore. The average total value of gold and silver recovered from these copper ores in 1907 was $0.313 to the ton. The average recovery of copper was 52.7 pounds of metal per ton of ore.

The production was derived from the well-known copper mines near Corinth, Strafford, and South Strafford, in Orange County. The deposits are large bodies of chalcopyrite and pyrrhotite in crystalline schists, and have long been identified with the history of mining in Vermont. Renewed interest and activity in these important ore deposits and better industrial conditions would seem to promise a considerable output in the immediate future.

The Pike Hill mines, of the Pike Hill Mines Company, are near Corinth and are developed by an adit 1,000 feet long, inclined shafts 475 and 200 feet deep, and by numerous crosscuts, winzes, and drifts. The plant consists of a 40-ton magnetic concentrating mill, and the picked ore and concentrates are shipped. The Corinth Copper Company has recently purchased the property of the Old Union mines and reports a large amount of exploratory work, all in ore, in the old Bicknell mine during the first ten months of 1907. This mine is said to be the original discovery of copper ore at Corinth and was located in 1846. Shipments of ore were made as a result of this development work, and up to the time of unfavorable market conditions the prospects seemed bright for the future. The Elizabeth mine, another famous Vermont producer in the past, has become the property of the Vermont Copper Company, and was under development in 1907 with a view to a daily output of from 300 to 500 tons per day. A new 400-ton blast furnace was completed during the year to replace the old 150-ton furnace. A concrete dam at Sharon on the White River to furnish 500 horsepower for mine and furnace was in course of erection in 1907, and an 8-mile transmission line was completed. It was planned to ship the product of this mine as matte. The development up to 1907 was an open cut 1,000 feet long and from 20 to 50 feet deep, a vertical shaft 300 feet deep, and a tunnel 400 feet long. During the year renewed interest was also shown in the Orange mine, near Strafford. This mine is developed by an inclined shaft to the 100-foot level and by drifts and crosscuts.

VIRGINIA.

Production of gold, silver, and copper in Virginia in 1906 and 1907.

Year.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		
1906	717.50	$14,832	250	$168	....	....	$15,000
1907	400.93	8,288	221	146	58,880	$11,776	20,210
Increase (+) or decrease (−)	−316.57	−6,544	−29	−22	+58,880	+11,776	+5,210

In 1907 Virginia produced 400.93 fine ounces of gold, valued at $8,288; 221 fine ounces of silver, valued at $146; and 58,880 pounds of copper, valued at $11,776. There was also an important production of lead, the figures for which are combined with those of New Hampshire in order that individual production be not published. The total value of the production of gold, silver, and copper in Virginia for 1907 was therefore $20,210, an excess of $5,210 over the value of the production in 1906. The production of gold and silver showed decreases, the former of 316.57 fine ounces, valued at $6,544, and the latter of 29 fine ounces, valued at $22, as compared with the production of 1906. The production of copper and lead, however, showed increased quantities and values, as there was no reported production for either of these metals in 1906. There were 7 mines reporting production in 1907, of which 6 were deep mines. From the deep mines 26,822 short tons of ore were raised. Of this, 1,128 short tons were of dry or siliceous ores, yielding an average extraction in gold and silver of $7.33 to the ton; 25,044 short tons were of siliceous-sulphide and pyritiferous copper ores giving an extraction of precious metals of $0.002 to the ton; and the remainder were lead ores yielding no silver or gold. The average recovery of copper from Virginia ores was 2.3 pounds of metal per ton of ore, and the average recovery of lead from Virginia and New Hampshire ores was 189.8 pounds to the ton.

In Carroll County the Goad and Gardner mine of the New York and Virginia Copper Company reported no production for 1907, but the probability that work would be resumed in 1908. This mine is developed by a 300-foot tunnel and winzes, and produces pyritic ores. In Halifax County lies the northern part of the important Virgilina gold-copper belt, which extends across the State line into Granville and Person counties, N. C. There are two low but well defined ridges in this section of the Piedmont Plateau, and along these the ore deposits are found. Until recently only copper ores consisting of chalcocite and bornite, with occasional chalcopyrite, and in siliceous gangue were worked; but within the last three years the Gold Banks mine, a late discovery on the East Ridge, has been a considerable producer of gold from siliceous ores without copper values. This mine is developed by a vertical shaft 200 feet deep and by 600 feet of levels and is equipped with a 20-stamp plate-amalgamation mill. The work has been chiefly for development purposes to date. As the stamp-mill practice has shown tailings too valuable to be ignored, a cyanide plant for an increased extraction was in process of erection in 1907. The Pontiac Copper mine, of the Pontiac Mining Company, reported no production for the year. This mine is developed by a vertical shaft 205 feet deep and by a number of pits along the outcrops. The High Hill mine of the Virginia Copper Company, at the northern end of the belt, also reported no production; but considerable experimental work was done during 1907 upon the Lamb leaching electrolytic process that it was thought would solve the problem of the treatment of the ores. The Chappel mine, of the Howard Mining Company, reported no production for 1907. The new 100-ton concentrating mill at the Seaboard mine of the Seaboard Copper Company was completed during the year, but work was confined largely to adjustment. This mill was making very clean concentrates of bornite and chalcocite from the siliceous ores, and reported a small production of copper, silver, and gold incidental to trial runs. A successful campaign was predicted for 1908. The mine is developed by 600 feet of shafts and 400 feet of levels, the deepest point reached in 1907 being 265 feet below the outcrop. Work at the Tallyhill mine was confined to prospecting during the year. Prospecting along new discoveries of gold veins was also reported in the Virgilina district in 1907.

In Louisa County the pyrite mines of the Arminius Chemical Company and of the Sulphur Mining and Railroad Company both reported important production of pyrites for the year. From the latter some cement copper was produced. From Page County the copper mines of the Blue Ridge reported no production for 1907. In Prince William County the Cabin Branch Mining Company mined considerable chalcopyrite in connection with pyrite at the Dumfries mine. In Stafford County there was a reported small production of placer gold, and the Austin Run Mining Company did development work in their pyrite mines near Garrisonville. These mines are apparently on the southwestern continuation of the Dumfries cupriferous-pyrite belt and may be expected to yield some copper. In Wythe County the zinc mines reported no production for the year. In Smyth County the Sugar Grove Lead mine of the Chamberlain Mineral Company reported an important production of lead during development work. This mine is opened by three 100-foot shafts, one 200-foot shaft, and 365 feet of levels and is equipped with a 150-ton concentrating mill.

COPPER.

By L. C. Graton.

INTRODUCTION.

The transformation of copper from its natural state in the earth's crust into the pure metal ready for consumption is a rather complex process which is accomplished in general by three successive operations—mining, smelting, and refining. In the smelting operation a part of the copper contained in the ore mined is lost, and loss likewise occurs in refining the product of the smelters. Furthermore, as these processes are applied to the same material at successive times a fluctuation in the quantity of copper mined does not appear till a later date in the smelter production, nor till still later in the refinery production. Figures representing the output from each of these operations during any year will therefore differ, and each set of figures, if properly explained or qualified, may be taken to represent the production of copper in that year.

The significance of each set of figures and the advantages and disadvantages which each possesses as a means of recording the progress of the copper industry have been considered in some detail elsewhere.[a] It may be briefly pointed out here that the mine production and the smelter production will differ (1) by the extent to which stocks of ore and intermediate smelter products are accumulated or depleted at the smelters during the year and (2) by the difference between the quantity of copper for which the mines receive pay and the quantity which the smelters actually produce. The smelter production and the refinery production differ (1) by the extent to which stocks of the final product of the smelters are accumulated or depleted during the year and (2) by the loss attendant on refining.

Figures representing all three stages of copper production have been compiled and are published in this report. The mine production, being reported direct from the primary sources of output, allows the most precise distribution of the total copper production according to locality of derivation, but is not in all cases wholly accurate as to quantity. The smelter production is, perhaps, distribution as to source and absolute quantity produced being considered, the most accurate measure of the actual copper production of the country and of each State. The refinery production shows the quantity of copper actually prepared for consumption during the year, but does not permit the most accurate distribution by States, and is liable to slight error through the possible inclusion of foreign material smelted in this country.

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[a] Mineral Resources U. S. for 1906, U. S. Geol. Survey, 1907, pp. 373–377.

The smelter output is chosen and considered in this report as the production of the country. It is made up of the production of blister copper and of the output of furnace-refined or so-called "ingot" copper of Michigan plus the Michigan copper cast into anodes for electrolysis. It thus consists in all cases of the final product of the distinctly smelting operations and does not include the product of any additional distinctly refining process.

SUMMARY OF STATISTICS.

The following statistical statement summarizes the copper industry in the United States in 1906 and 1907:

Summary of statistics of the copper industry in the United States in 1906 and 1907.

	1906.	1907.
Production of copper:		
Smelter output..........pounds..	917,805,682	868,996,491
Mine production..........do....	916,971,387	847,151,015
Refinery production of new copper:		
Electrolytic..........do....	648,614,592	592,326,608
Lake..........do....	205,608,382	178,534,141
Casting..........do....	33,459,413	13,410,678
Total domestic..........do....	887,682,387	784,271,427
Total domestic and foreign..........do....	1,079,052,409	1,032,516,247
Total new and old copper..........do....	1,129,052,409	1,093,001,831
Total ore treated..........short tons..	19,743,000	21,403,000
Copper ore treated..........do....	18,000,000	20,253,000
Average yield of copper..........per cent..	2.50	2.11
Imports, in terms of refined copper..........pounds..	215,402,841	238,031,320
Exports, in terms of refined copper..........do....	446,750,711	465,496,007
Consumption of new copper:		
Electrical purposes..........do....	340,000,000	220,000,000
Brass manufacture..........do....	210,000,000	150,000,000
Copper sheets, etc..........do....	35,000,000	30,000,000
Castings, etc..........do....	100,000,000	85,000,000
Total..........do....	685,000,000	485,000,000
Total new and old copper..........do....	735,000,000	545,000,000
World's production..........do....	1,596,973,700	1,589,809,300

PRODUCTION.

GENERAL CONDITIONS OF INDUSTRY.

In perhaps no previous year of its history did the copper industry of the United States experience such varied commercial conditions as were brought to it by the year 1907. Prices generally better than 15 cents per pound, which had prevailed for more than two years previously and had risen to an unusually high level in 1906, had stimulated the industry as never before. New mines had been started, former producers had been revived, many of the large producing companies had recently increased their capacities, and others were about to do so.

The copper industry at the beginning of 1907 inherited from the preceding year a condition of unusual activity in all lines of business and every indication of prosperity throughout the country, an unequaled demand for home consumption, an export business nearly up to the record in volume, and conditions in the producing branch of the industry that, in spite of numerous misfortunes, had made possible an increase in 1906 of about 29,000,000 pounds over the previously unequaled production of 1905. The year opened with electrolytic copper selling at 23.8 cents, the highest price in twenty-six years. The only exceptions to these favorable conditions—shortage of labor, fuel, and supplies and congested transportation—were simply the outcome of this extreme prosperity, and all but the first of these were largely relieved by the second quarter of the year.

Under these propitious circumstances and with no indication of their abatement, producers looked forward to a year of unparalleled production and profits. For the first few months of 1907 these encouraging conditions continued and with augmented effect. In February and the early part of March the price of electrolytic copper reached 26 cents, and consumers, fearing even higher levels, were buying heavily for delivery even five and six months ahead. As to just what occurred after that, and why, opinions differ. The sharp break in securities in the latter part of March may have acted as a warning of the financial stringency that was to follow and served to check the excessive pace at which expansion of various industries had been carried on during the two or three years preceding. Certain it is that steady buying by domestic consumers stopped, and exports fell off in April and May. Buyers, with their needs supplied for several months in advance, seemed willing to let the producers show their strength. With the lessening demand, the sellers at first held firm, but soon the smaller independent sellers made slight concessions in order to effect sales. While certain of the larger selling interests maintained a nominal price of about 25 cents, the smaller agencies sold, at progressively lower figures, enough copper to satisfy the immediate requirements of those consumers who had not bought ahead. At this indication of weakness on the part of producers, the larger consumers, relying almost solely on the supplies already contracted for, remained out of the market, and in consequence the stocks of metal in the refiners' hands began to accumulate rapidly. Exports increased a little as the result of lower prices in June, but the largest seller was disposing of little copper at its established price of 25 cents. Finally, in the early part of July, this company dropped its price to 22 cents. Other agencies made a slightly lower price and secured much of the business done at that level. From that time the price fell rapidly, quotations dropping 1 or 2 cents at a time in some instances, until in October electrolytic was quoted at less than 12 cents.

Closely following this decline in the price of copper came a period of financial instability and finally of depression. For two years, by virtue of the high prices and proportionate profits, copper and the copper shares had occupied the center of the speculative arena and had come to be regarded as a barometer of the financial atmosphere. There can be little doubt that this sudden fall in copper and copper stocks shook the entire financial structure and was partly instrumental in bringing about the critical conditions that ensued. Under these conditions consumption fell off decidedly, and this, together with the general financial uncertainty, operated to keep the price of copper down to the low level it had reached. The enormous volume of exports at the low market caused a slight reaction in price in November, but this was of short duration, and prices receded to a low point, where sales again became large. The year closed with the market firm and with electrolytic selling at about 13.5 cents per pound.

This reversal of conditions from those of the early part of the year of course had a marked effect on production. Low prices and scarcity of money forced many producers, especially among the younger and smaller mines, to close down. The Amalgamated Copper Company and many other producers that sell through the United Metals Selling Company, as well as some independent companies, materially reduced their output during the last three months of the year. It is estimated that from the total indicated by the first eight months' operations there was a decline in the smelter output of about 110,000,000 pounds, and the actual production of the year, instead of having been 61,000,000 pounds greater than that of 1906, was almost 49,000,000 pounds less. The decline in mine production was still greater, and, coming as it did toward the end of the year, it will tend somewhat to lower the smelter output for 1908. The refineries, however, escaped much of the effect of the last two months of the mine curtailment in 1907, and their reduction in receipts will therefore not reach the maximum until 1908.

The average cost of producing a pound of copper fell off in some instances and partly compensated those companies that remained in operation for the lowered prices they received. This reduction of costs was due in part to abandoning production from the lowest grade ores and in part to the exercise of general economy, such as reduction of force, lowering of wages, and limiting development; but it was the result as much as anything else of the marked increase in the efficiency of labor when the business depression made labor plentiful. On the other hand, certain companies that either curtailed or made no effort to increase their production took advantage of the increased efficiency of labor to push development work. In such cases the total charge against the copper produced of course increased the cost per pound.

It is to be remarked in this connection that the average of yearly prices of copper for the twenty-five years from 1883 to 1907 has been about 13 to 13.25 cents per pound—that is, just about the price at which the market has now found a level. The present price undoubtedly represents a reaction from the excessive prices of the last two years to a point beyond the position of economic equilibrium—a condition which could probably have been largely avoided had the declining demand during the second quarter of 1907 been met by corresponding gradual reductions in price. While full production from the new low-cost mines of Utah, Nevada, and Arizona will in the near future tend to reduce the average cost of copper production, there can be no question that under the conditions of production actually existing to-day the average price for the last twenty-five years and that now current is too low, and if long maintained under present conditions would cause a marked decline in production. For, although by virtue of extended transportation, highly improved methods, and greatly increased capacities the cost of treating a ton of ore has steadily decreased, in spite of greater depths of mining and more careful recovery, yet the constant decline in tenor of the ores treated, as regards both copper and the precious metals, has brought the net cost charged against each pound of copper produced to a distinctly higher figure than ruled even a few years ago. It was estimated[a] from reliable data that in 1888 practically 80 per cent of the copper then produced in the United States was made at a cost which would allow production to continue profitably with the price of the metal at 10 to 10½ cents per pound. No discussion is required to show that such conditions do not obtain to-day.

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[a] Kirchhoff, C., Mineral Resources U. S. for 1888, U. S. Geol. Survey, 1889, pp. 47-48.

Regardless of any attempted manipulation of the price of copper—which may be expected to continue in the future as it has in the past—it would seem that the producers of copper would do well to regard and direct their industry more than they now do from the standpoint of the merchant or manufacturer, as a matter of business in which good years and bad years are to be expected with the changing conditions of the world's trade and are to be made to balance each other as far as possible by continuous and practically uniform operations. If such an attitude were reflected in actual practice the copper industry of the country would undoubtedly be freer from depressions of the kind experienced at present and at various times in the past, and the average volume of profits would undoubtedly be greater. The policy of many of the Michigan companies in this respect is especially commendable, and their dividend records attest that the effects of such a policy are not solely altruistic.

SMELTER AND MINE PRODUCTION.

GENERAL STATEMENT.

The production of copper in the United States in 1907, as measured by the smelter output, was 868,996,491 pounds. The production of 1906, compiled on the same basis, was 917,805,682 pounds, and that of 1905 was 888,784,267 pounds. From the record production of 1906 the output for 1907 shows a decrease of 48,809,191 pounds, or 5.3 per cent. This is the largest actual decrease ever recorded, and is the largest relative decrease since 1886, when the percentage of decrease was 5.5. In 1907, for the first time since 1901, was the production smaller than that of the preceding year, and for the first time since 1872 was the production smaller than for the second preceding year.

The yearly production of copper in the United States from 1845 to 1907, inclusive, together with the actual and relative changes from each year preceding, is given in the following table:

Magnitude and growth of copper production in the United States from 1845 to 1907, inclusive.

Year.	Production.	Increase.		Average annual increase by decades.	
	Pounds.	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*
1845	224,000	....	....	242,400	50.0
1846	336,000	112,000	50.0		
1847	672,000	336,000	100.0		
1848	1,122,000	450,000	67.0		
1849	1,568,000	426,000	40.0		
1850	1,456,000	[a] 112,000	[a] 7.1		
1851	2,016,000	560,000	23.1	1,467,200	27.0
1852	2,464,000	448,000	22.2		
1853	4,480,000	2,016,000	81.8		
1854	4,990,000	510,000	12.5		
1855	6,720,000	1,730,000	33.3		
1856	8,960,000	2,240,000	33.3		
1857	10,752,000	1,792,000	20.0		
1858	12,320,000	1,568,000	14.6		
1859	14,112,000	1,792,000	14.5		
1860	16,128,000	2,016,000	14.3		

[a] Decrease

Magnitude and growth of copper production in the United States from 1845 to 1907, inclusive—Continued.

Year.	Production.	Increase.		Average annual increase by decades.	
	Pounds.	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*
1861	16,800,000	672,000	4.1	1,209,600	6.1
1862	21,160,000	4,360,000	20.0		
1863	19,040,000	[a]2,120,000	[a]5.5		
1864	17,920,000	[a]1,120,000	[a]5.9		
1865	19,040,000	1,120,000	6.3		
1866	19,936,000	896,000	4.7		
1867	22,400,000	2,464,000	12.3		
1868	25,984,000	3,584,000	16.0		
1869	28,000,000	2,016,000	7.7		
1870	28,224,000	224,000	1.0		
1871	29,120,000	896,000	3.2	3,225,600	7.2
1872	28,000,000	[a]1,120,000	[a]3.8		
1873	34,720,000	6,720,000	24.0		
1874	39,200,000	4,480,000	12.9		
1875	40,320,000	1,120,000	2.9		
1876	42,560,000	2,240,000	5.6		
1877	47,040,000	4,480,000	10.5		
1878	48,160,000	1,120,000	2.4		
1879	51,520,000	3,360,000	7.0		
1880	60,480,000	8,960,000	17.4		
1881	71,680,000	11,200,000	18.6	18,930,349	14.8
1882	90,646,232	8,966,232	12.5		
1883	115,526,053	24,886,221	27.4		
1884	144,946,653	29,420,600	25.5		
1885	165,875,766	20,929,113	14.4		
1886	156,735,381	[a]9,140,385	[a]5.5		
1887	180,920,524	24,185,143	15.4		
1888	226,361,466	45,440,942	25.1		
1889	226,775,962	414,496	.2		
1890	259,763,092	32,987,130	14.5		
1891	284,121,764	24,358,672	9.4	34,635,407	9.1
1892	344,998,679	60,876,915	21.5		
1893	329,354,398	[a]15,644,281	[a]4.8		
1894	354,188,374	24,833,976	7.5		
1895	380,613,404	26,425,030	7.4		
1896	460,061,430	79,448,026	20.9		
1897	494,078,274	34,016,844	7.4		
1898	526,512,987	32,434,713	6.6		
1899	568,666,921	42,153,934	8.0		
1900	606,117,166	37,450,245	6.6		
1901	602,072,519	[a]4,044,647	[a].7	37,554,189	5.5
1902	659,508,644	57,436,125	9.5		
1903	698,044,517	38,535,873	5.8		
1904	812,537,267	114,492,750	16.4		
1905	888,784,267	76,247,000	9.4		
1906	917,805,682	29,021,415	3.3		
1907	868,996,491	[a]48,809,191	[a]5.3		

[a] Decrease.

SUMMARY.

Years.	Total production.	Average annual increase.	
		Quantity.	Per cent.
	Pounds.	*Pounds.*	
1845–1907	12,163,637,913		
1846–1907		13,880,213	15.0
1846–1881		2,034,333	17.2
1882–1907		30,282,201	9.9

The figures, except those for 1907, are taken from previous volumes of the Mineral Resources of the United States. Statistics from 1882 to 1907, inclusive, are based on accurate returns to the Geological Survey by the copper-producing companies of the country. Figures for years prior to 1882 were taken from the best sources available.

The year 1845 is the first for which reasonably trustworthy figures seem to have been compiled, and that year marked the entrance into the producing ranks of the Lake Superior district, which for many years thereafter was the principal source of the country's production. In the early eighties our production began to stamp the United States as one of the great producers of copper, and, since in 1882 for the first time accurate statistics of production were collected, the era of copper production in the United States may conveniently be divided into two periods at the beginning of 1882.

The table shows that the growth in production has been constant and that in recent years it has been enormous. The total production for the thirty-seven years from 1845 to 1881, inclusive, was slightly under 800,000,000 pounds, while in the twenty-six years from 1882 to 1907, inclusive, the aggregate production has been more than fourteen times as much, namely, over 11,300,000,000 pounds. The average yearly increment to production during the years 1846–1850 was less than 250,000 pounds, whereas the average annual increase for the seven years 1901–1907 has been over 37,500,000 pounds. Enormous as this growth has been, however, the rate of growth is plainly decreasing, as is shown by the average annual rate of increase over periods—like decades—long enough to cover the inevitable fluctuations from year to year. Compared with an average yearly increase of 50 per cent in 1846–1850, and of 17.2 per cent in 1846–1881, the average yearly growth since the copper industry of the United States became important has been only 9.9 per cent, and for the last seven years the average rate of increase is only 5.5 per cent.

Going back for about twenty years, it is seen from the foregoing table that the present decrease in production is the fourth decrease within that period from about a normal rate of growth. The first of these, which was not an actual decrease, occurred in 1889 as a result of the collapse of the Sécretan syndicate. The second, in 1893, was caused by the panic of that year. The third was brought about in 1901 in an unsuccessful effort to maintain prices. The causes of the present decline need not be repeated. In all but the second case these declines started at a time of high prices, when producers were making particular efforts to increase their output. In each case they were accompanied or immediately followed by distinctly lower prices. For the eighteen years 1889–1906 the average annual rate of increase was 8.2 per cent. It is interesting to note how this increase varied after each of the first three decreases. In the year following the decline the production regained about its normal rate of growth and held this rate during the second year, while the effects of the conditions that caused the decline were wearing off. By the third year, however, came the effect of the increase in capacities which had been started at the time of the decline, and in that year the increase of production showed an advance large enough to compensate for the year of reduced output. After this accumulated capacity had thus been put into operation the production again resumed its normal rate of growth,[a] except in the case of the panic of 1893, when the operative causes were external and not the result of conditions arising within the copper industry. It would thus seem that there has been a regularity in the recovery from decreased production. The year of decline is followed by two of normal growth, and the third, completing the cycle with an abnormally high rate of increase that balances the preceding decrease, prepares the way for continuance of production at the average rate of growth. The decrease which the production of 1908 will probably show over that of 1907 would appear not to harmonize with this cycle, but future years may show that the only point of difference is that the present decline in production is of longer duration than those preceding, which affected substantially only a single calendar year.

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[a] The average rate of increase in 1906 would have been nearly or quite achieved had it not been for a train of handicaps, of which shortage of labor, severe weather, and congested transportation were of most importance.

It is not to be expected, however, that an average increase of 8 per cent can be maintained indefinitely. Rather is it probable that under a continuance of the copper prices which have obtained during the last twenty-five years the rate of increase will continue, on the whole, to decline, although possibly not at a rapid rate. Furthermore, the time does not seem far distant when the actual increase in quantity produced will cease to grow. There is no reason to doubt, however, that a production equal to that of the last two or three years can be maintained under reasonably favorable circumstances for many years to come.

SMELTER RETURNS.

The figures of smelter production for 1907 are based on direct returns made confidentially to the Geological Survey by all but one of the known smelting companies that handled United States ores, concentrates, or mattes in 1907. To all companies and officers who have aided in furnishing information sincere thanks are extended. The following list gives the names of the owning or operating companies, the location, and the final copper product of all known plants, 81 in number, which contributed to the copper production in 1907:

Smelting plants that treated United States copper in 1907.

Location.	Company.	Final copper product.
UNITED STATES.		
Alaska: Hadley	Alaska Smelting and Refining Co	Matte.
Arizona:		
Christmas	Saddle Mountain Mining Co	Do.
Clifton	Arizona Copper Co	Blister.
Do	Shannon Copper Co	Do.
Douglas	Calumet and Arizona Mining Co	Do.
Do	Copper Queen Consolidated Mining Co	Do.
Globe	Old Dominion Copper Mining and Smelting Co	Do.
Helvetia	Helvetia Copper Co	Matte.
Humboldt	Consolidated Arizona Smelting Co	Blister.
Jerome	United Verde Copper Co	Do.
Morenci	Detroit Copper Mining Co	Matte and blister.
Washington	Duquesne Mining and Reduction Co	Matte.
California:		
Campo Seco	Penn Chemical Co	Do.
Copperopolis	Union Copper Co	Do.
Ingot	Great Western Gold Co	Do.
Kennett	Mammoth Copper Mining Co	Do.
Keswick	Mountain Copper Co	Do.
Martinez	do	Blister and electrolytic.
Do	Peyton Chemical Co	Matte.
Needles	Arizona-Mexican Mining and Smelting Co	Do.
Selby	Selby Smelting and Lead Co.[a]	Lead furnace matte.
Colorado:		
Canyon City	United States Smelting Co	Matte.
Denver	American Smelting and Refining Co	Lead furnace matte.
Do	Boston and Colorado Smelting Co	Matte.
Durango	American Smelting and Refining Co	Lead furnace matte.

[a] Subsidiary of American Smelters Securities Company.

Smelting plants that treated United States copper in 1907—Continued.

Location.	Company.	Final copper product.
UNITED STATES—con.		
Colorado—Continued.		
Leadville	American Smelting and Refining Co	Lead furnace matte.
Pueblo	do	Do.
Salida	Ohio and Colorado Smelting and Refining Co	Do.
Silverton	Ross Mining and Milling Co	Matte.
Idaho:		
Ivers	Lost Packer Mining Co	Do.
Mackay	Empire Copper Co	Do.
Ponderay	Panhandle Smelting Co., (Limited)	Lead furnace matte.
Illinois:		
Aurora	American Smelting and Refining Co	Matte.
Blue Island	Chicago Copper Refining Co	Casting.
Maryland: Baltimore	Baltimore Copper Smelting and Rolling Co. [a]	Electrolytic and casting.
Michigan:		
Hancock	Lake Superior Smelting Co	Anodes and Lake.
Do	Quincy Mining Co	Do.
Houghton	Michigan Smelting Co	Do.
Hubbell	Calumet and Hecla Mining Co	Do.
Missouri: Fredericktown	North American Lead Co	Blister and electrolytic.
Montana:		
Anaconda	Washoe Copper Co	Blister.
Butte	Colusa-Parrot Mining and Smelting Co	Do.
Do	Pittsburg and Montana Copper Co	Do.
East Helena	American Smelting and Refining Co	Lead furnace matte.
Great Falls	Boston and Montana Consolidated Copper and Silver Mining Co.	Blister and electrolytic.
Nebraska: Omaha	American Smelting and Refining Co	Blister.
New Jersey: [b]		
Chrome	United States Metals Refining Co	Electrolytic and casting.
Maurer	American Smelting and Refining Co	Electrolytic.
Newark	Balbach Smelting and Refining Co	Electrolytic and casting.
Perth Amboy	Raritan Copper Works	Electrolytic.
New Mexico:		
Deming	National Mining and Smelting Co	Lead furnace matte.
Oro Grande	Southwest Smelting and Refining Co	Matte.
San Pedro	Santa Fe Gold and Copper Co	Do.
Silver City	Comanche Mining and Smelting Co	Do.
New York:		
Black Rock	Buffalo Smelting Works	Lake and electrolytic.
Laurel Hill	Nichols Copper Co	Electrolytic and casting.
Oregon:		
Sumpter	Oregon Smelting and Refining Co	Matte.
Takilma	Takilma Smelting Co	Do.
Pennsylvania: [b] Carnegie	Pennsylvania Smelting Co	Lead furnace matte.
Tennessee:		
Copperhill	Tennessee Copper Co	Blister.
Isabella	Ducktown Sulphur, Copper and Iron Co. (Ltd.)	Matte.
Texas: El Paso	American Smelting and Refining Co	Do.
Utah:		
Bingham	Yampa Smelting Co	Do.
Bingham Junction	Bingham Consolidated Mining and Smelting Co.	Blister.
Do	United States Smelting Co	Do.
Garfield	Garfield Smelting Co. [a]	Do.
Murray	American Smelting and Refining Co	Lead furnace matte.
Do	Utah Consolidated Mining Co	Blister.
Ogden	Utah Smelting Co	Matte.
Shem	Utah and Eastern Copper Co	Matte and black copper.
Vermont: South Strafford	Vermont Copper Co	Matte.
Virginia: West Norfolk	Eustis Smelting Co	Do.
Washington:		
Everett	Puget Sound Reduction Co. [a]	Lead furnace matte.
Northport	Northport Smelting and Refining Co	Matte.
Tacoma	Tacoma Smelting Co. [a]	Blister and electrolytic.
Wyoming: Encampment	Penn-Wyoming Copper Co	Blister.
CANADA.		
British Columbia:		
Crofton	Britannia Smelting Co. (Limited)	Blister.
Greenwood	British Columbia Copper Co. (Limited)	Do.
Ladysmith	Tyee Copper Co. (Limited)	Matte.
MEXICO.		
Sonora: Cananea	Cananea Consolidated Copper Co	Blister.
Aguas Calientes: Aguas Calientes.	American Smelting and Refining Co	Do.

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[a] Subsidiary of American Smelters Securities Company.

[b] This list does not include a smelter in New Jersey and one in Pennsylvania, both of which make blister from material solely of foreign origin.

The figures of production represent actual smelter recovery. That part of the total credited to Michigan consists of the portion of that State's output that was refined by the furnace process without electrolysis, plus the copper cast in anodes for electrolytic refining. The fine copper content instead of the gross weight is given in the case of blister or converter copper and in the case of the black copper bullion produced by one company. One company's product consisted in part of electrolytic copper made without the production of an intermediate smelter product, and another company made casting copper direct from ore and matte; in both these cases the refined copper is included in the total. In 1906 three large companies reported part or all of their output as electrolytic copper, and statistics as to their smelter production proper could not be secured. It is gratifying to state that for 1907 two of these companies furnished statistics of production both of their smelters and of their refineries. One large company, however, that operates several smelters and a refining plant still withheld figures of its blister production and gave only the data concerning its electrolytic output. The loss which attended the transformation of this quantity from blister into electrolytic is practically equivalent to the copper content of the bluestone recovered as a by-product in the refining process. In order to bring the returns of this company as nearly as possible to the basis on which other companies reported, the copper content of the bluestone produced by this company is added pro rata to the state production figures which it reported. A small error is probably introduced, however, since no allowance can be made for the difference between the quantity of this company's pig copper in transit and in stock during the latter part of 1906 and the quantity in transit and in stock during the corresponding period of 1907. With these exceptions the figure for total production is believed to be exact. The accurate exclusion of foreign material has been permitted by the carefully prepared data submitted by the companies, and with the cooperation of the refining companies the inclusion of secondary materials, like scrap and old copper, has been avoided.

The copper output for 1907 was produced in the form adopted for compilation—blister and Lake copper—by 35 smelting plants in 14 States and in Canada and Mexico. The production of the smelters in the various regions is shown in the accompanying table. In order that the output of individual works may not be disclosed, the figures for certain States are combined. The output of plants that produce only matte is not included in this table.

Production of copper in 1907, apportioned according to locality in which finally smelted, in pounds.

Locality.	Domestic.	Foreign.[a]	Total.
Arizona	255,381,136	13,597,404	268,978,540
Montana	226,578,864		226,578,864
Michigan	180,425,707		180,425,707
Utah	91,212,542		91,212,542
Maryland, New Jersey, and New York	51,381,415	[b] 37,487,870	88,869,085
Illinois, Missouri, Nebraska, and Wyoming	20,162,643		20,162,643
California and Washington	18,134,289	13,060,574	31,194,863
Tennessee	15,644,847		15,644,847
Total by domestic plants	858,921,443	64,145,648	923,067,091
Mexico	8,809,788		
Canada	1,265,260		
Total by foreign plants	10,075,048		
Grand total	868,996,491		

[a] The production from foreign material by two smelters is approximate.

[b] Included in this quantity is the product of two smelters, one in New Jersey and one in Pennsylvania, which handled only foreign material.

It is seen from the table that the four largest copper-producing States smelt the greater part of their own output, and that in the case of all of these except Michigan custom materials are handled in addition. Arizona treats most of its own ores, but receives little from outside sources except Mexico. Montana ores are smelted almost entirely within the State, and in addition a notable quantity of Idaho ore is handled. The smelting done in Michigan is wholly on local concentrates.[a] Utah smelts most of its own ores and in addition handles principally matte, derived from many sources, but chiefly from California. A large part of the production of Tennessee is converted into blister within the State, and a small amount of outside ore is also treated. Much of the matte produced by lead and copper smelters in Colorado, and some from other sources, is converted in Nebraska. Miscellaneous lots of ore and matte from various parts of the country are handled by the refineries on the Atlantic coast and in Illinois, and in addition the seaboard works treat large quantities of foreign ores and mattes. A considerable part of the Michigan output is smelted and refined in New York State. California works make a portion of the total blister production of the State and handle a little from outside sources. Blister copper made in Washington is mainly from Alaska and foreign sources, but Washington itself and near-by States are drawn upon for small quantities of ore and matte. Ore from Arizona and matte from Texas go to works in Mexico. Ores from Alaska, Idaho, and Washington are handled in Canadian smelters.

Ranking after Utah, which is fourth in the amount of final smelter output, domestic and foreign, come in order New York, Washington, Tennessee, Nebraska, New Jersey, and California. The other States are of comparatively small importance. The principal States in which custom converting was done in 1907 are, in order of importance, New York, Utah, New Jersey, Nebraska, Arizona, and Washington.

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[a] See page 60 relative to Montana cathodes.

It will be seen that of the domestic production of copper, 10,075,048 pounds were produced as blister in foreign smelters, and that works in this country turned out as blister 64,145,648 pounds from foreign materials, making the total final output of smelting plants in the United States 923,067,091 pounds.

The table which follows shows the distribution, according to location of plants, of the domestic product made from shipments direct from the mines. The figures represent for the most part blister and Lake copper, but the product from custom matte is excluded, while on the other hand there is included the copper content of a large quantity of matte produced by plants that do not operate converters.

Copper product from domestic ore and concentrates smelted in 1907, apportioned according to locality in which first smelted, in pounds.

Alaska, Oregon, Washington, and Canada	9, 975, 467
Arizona and Mexico	254, 383, 813
California	33, 517, 509
Colorado	12, 516, 278
Idaho and Wyoming	5, 781, 339
Michigan	180, 425, 707
Missouri, Nebraska, and Illinois	831, 641
Montana	227, 872, 429
New Mexico and Texas	11, 028, 261
Tennessee	19, 955, 748
Utah	68, 394, 019
Vermont, Virginia, and Pennsylvania	239, 743
Maryland, New Jersey, and New York	39, 926, 324
Total	864, 848, 278

A comparison of this table with that on page 18, which gives the copper production of the various States, shows close correspondence and indicates that by far the greater part of the copper produced is smelted, at least to the extent of making matte, close to the mines, either in the States where mined or in immediately adjoining States. This is, of course, a very different condition from that which existed when high-grade ores were produced generally and were to a large extent shipped to distant smelting centers. The only important exception to the present practice of smelting close to the source of the ore is New York, but in that case most of the material is high-grade concentrates from Michigan. The combined contribution of Canada and Mexico to the total above was 4,991,799 pounds, most of which was produced as matte in Canada and converted in this country. The principal States in which domestic matte is produced and shipped to other plants for conversion are as follows, in order of importance: California, Colorado, Texas, Utah, Tennessee, Idaho, and New Mexico. Of the total product that was ultimately turned out as blister—approximately 650,000,000 pounds—about 76,000,000 pounds, or nearly 12 per cent, were produced by converting custom matte.

It will be noted that the total in the preceding table is lower than that in the table on page 15. This is, of course, accounted for by the fact that the matte-producing plants produced less from January 1 to December 31 than was recovered from their matte by the custom converting plants during the same period. In other words, the curtailment of mine production which was made in the latter part of the year is more closely reflected by the matte output than by the blister output. If the loss in converting the 76,000,000 pounds contained in custom matte be placed at, say 1.3 per cent of the copper handled, or about 988,000 pounds, then it appears that while the 76,000.000 pounds was being derived from custom matte at the converting plants, new matte that would yield only about 70,864,000 pounds blister was being produced at the matte smelters, a decline by the matte smelters of nearly 7 per cent.

MINE RETURNS.

In 1907 for the first time systematic reports of copper output were received from the mines of every copper-producing State, mine returns not having been collected in previous years from a few States of little importance as producers. The figures of mine output are based on reports collected by the field agents of the Geological Survey from all mining companies in the country which produced copper in 1907, with the exception of one company in the West, from which no satisfactory report could be obtained and whose production was therefore estimated. Details of mining operations and output by counties and districts are given in the general report on mine production which forms a part of the Mineral Resources volume for 1907.

The quantity of copper reported as the output of the mines of the United States in 1907 was 847,151,015 pounds, a quantity 21,845,476 pounds, or 2.5 per cent, less than the product of the smelters for the same period. By far the greater portion of the mines' output is treated directly in smelters owned by or affiliated with the mining companies, and this large part of the mine production is reported on practically the same basis as the smelter production. But in most cases the mine returns are based on the actual or estimated recovery from the ore *shipped from the mines* during the year, whereas the smelter returns indicate the quantity of copper actually *turned out at the reduction works* in that period. In the case of States like Montana, therefore, operation of the smelters at full capacity for a few days after the mines had begun to reduce shipments would account for a distinct excess in smelter output over that reported by the mines. This fact, that when curtailment of production had once been decided on, the mines were able to execute the plan more promptly than the smelters, is responsible for the greater part of the difference between mine and smelter production in 1907. In 1906, when mine and smelter operations were conducted at practically the same rate, returns from the two sources were in very close correspondence, the mine output having been only 834,295 pounds, or 0.9 per cent, less than the production of the smelters. A second cause of the difference in favor of the smelter figures results from the fact that the smelters recover a greater quantity of copper than the mines are paid for. The difference on this account is smaller than that due to the other cause, but is especially important in the case of States like Colorado, where the greater part of the production is from custom ores generally low in copper.

PRODUCTION BY STATES.

Copper was produced in 1907 in twenty-one States and Territories. The contribution of each to the total production for the year is shown in the following table, in which there are also given the output from the mines and the corresponding statistics for 1906. The differences in the totals of smelter and mine production have already been discussed. Corresponding differences in the state figures will be considered in the account of the industry in each State.

Production of copper by smelter returns in 1906 and 1907, compared with mine returns for same years, in pounds.

State.	1907.				1906.	
	Production.			Mine returns.	Production, smelter returns.	Mine returns.
	Rank.	Percentage of total.	Smelter returns.			
Alaska	10	0.81	7,034,763	6,308,786	8,685,646	5,871,811
Arizona	1	29.55	256,778,437	254,879,489	262,566,103	266,831,864
California	5	3.88	33,696,602	28,528,020	28,153,202	28,726,448
Colorado	7	1.61	13,998,496	7,724,590	7,427,253	5,720,929
Georgia	....	....	(a)	(a)	17,182	26,198
Idaho	9	1.12	9,707,299	10,890,731	8,578,046	9,558,913
Massachusetts	....	....	....	....	9,744	[c] 9,744
Michigan	3	25.22	219,131,503	217,767,232	229,695,730	224,572,310
Missouri	....	....	(b)	(b)	54,347	[c] 54,347
Montana	2	25.81	224,263,789	220,108,792	294,701,252	290,700,975
Nevada	12	.22	1,998,164	1,782,571	1,090,635	1,625,985
New Mexico	8	1.17	10,140,140	10,990,015	7,099,842	7,028,670
North Carolina	14	.061	544,040	582,082	582,209	703,775
Oregon	15	.059	518,694	554,104	545,859	415,803
Tennessee	6	2.24	19,745,119	18,893,115	17,809,442	17,979,317
Texas	....	....	....	....	51,377	[c] 51,377
Utah	4	7.64	66,418,370	64,256,884	50,329,119	56,593,576
Vermont	13	.08	696,102	650,425	11,694	240,315
Virginia	19	.007	57,008	58,880	....	....
Washington	17	.013	122,263	297,812	290,823	235,030
Wyoming	11	.35	3,026,004	2,257,650	106,177	24,000
Alabama	18	.01	90,655	619,737		
Georgia	21				....	....
Maryland	20					
Missouri	16	.15	1,299,043		....	....
Unapportioned	....					
Total	....	100.000	868,996,491	847,151,015	917,805,682	916,971,387

[a] Included with Alabama and Maryland.
[b] Included with "Unapportioned."
[c] Smelter figures accepted for mine output.

The allotment of the total smelter production to the initial sources can not be made directly from the returns furnished by the blister producers, since the product from custom matte is credited by them wholly to the State in which the matte smelter is located, whereas many of the matte smelters actually treat materials from a number of States. Some adjustment is therefore necessary before the true state output can be ascertained, and on this account the figures of state production are not so certainly accurate as those representing the total smelter output. Since, however, the adjustment has been made on the basis of production of every company, whether producers of blister and Lake copper or only of matte, and has been properly checked against the mine returns in all cases, it is believed that the state figures are exceedingly close to the truth. The only case in which there is reason to doubt their accuracy is for Wyoming, where the statement of smelter production made by one company was not satisfactory and was not accompanied by a report of mine production. A very small quantity, less than 0.1 per cent of the total, could not be allotted with certainty and is included with the production of Missouri. The production of three Southern States is grouped to avoid disclosing individual production.

On the basis of statistics gained from both mines and smelters it is possible to make a still further subdivision of the total production into the output of the important mining districts.

In the following table is given for 1907 the production of all districts whose output yielded, on smelting, 2,000,000 pounds or more:

Copper production of principal districts in 1907, in pounds.

District or region.	State.	Approximate smelter output.	Percentage of total production.	Rank.
Butte	Montana	222,000,000	25.55	1
Lake Superior	Michigan	219,000,000	25.20	2
Bisbee	Arizona	110,000,000	12.66	3
Morenci	do	63,000,000	7.25	4
Bingham	Utah	47,000,000	5.41	5
Globe	Arizona	35,000,000	4.03	6
Jerome	do	33,000,000	3.80	7
Shasta County	California	28,000,000	3.22	8
Ducktown	Tennessee	19,500,000	2.24	9
Tintic	Utah	7,800,000	.90	10
Coeur d'Alene	Idaho	6,600,000	.76	11
Leadville	Colorado	5,700,000	.66	12
Silverbell	Arizona	5,600,000	.64	13
Southeastern Alaska	Alaska	5,400,000	.62	14
Santa Rita	New Mexico	5,000,000	.58	15
Frisco	Utah	4,900,000	.56	16
Calaveras County	California	4,500,000	.52	17
Encampment	Wyoming	2,900,000	.33	18
White Knob	Idaho	2,800,000	.32	19
San Juan	Colorado	2,600,000	.30	20
Lucin	Utah	2,200,000	.25	21
Burro Mountain	New Mexico	2,100,000	.24	22
Total		834,600,000	96.04	
All others		34,400,000	3.96	
Grand total		869,000,000		

It is seen that these 22 districts, situated in 11 States and Territories, contributed over 96 per cent of the entire production of the country, and that the first 9 of these districts, situated in 6 States and Territories, produced almost 90 per cent of the total. Arizona has 5 important districts, Utah 4, California, Colorado, Idaho, and New Mexico 2 each, while Alaska, Michigan, Montana, Tennessee, and Wyoming have only 1 important producing region each. The mine returns from these 22 districts indicate an output of 817,856,536 pounds, or just about 2 per cent less than the smelter production from them. Returns from all producing mines outside of these districts show an output of 29,294,479 pounds, which is nearly 15 per cent lower than the 34,400,000 pounds turned out by the smelters. This shows that these scattered mines, generally farther from smelting works than those in the larger districts, did not affect the smelter output so promptly when they curtailed production or closed down toward the end of the year. It is also plain that these smaller mines, most of which ship to custom works, were especially affected by the difference which arises between copper paid for and copper recovered at the smelting works.

The following table gives for purposes of general comparison the copper production of each State for which separate statistics have been recorded from 1882 to 1907, inclusive. All except those for 1907 have appeared in previous volumes of Mineral Resources:

Production of copper in the United States, 1882–1907, by States, in pounds.

State.	1882.	1883.	1884.	1885.	1886.	1887.
Alaska	....	....	....	....	....	....
Arizona	17,984,415	23,874,963	26,734,345	22,706,366	15,657,035	17,720,462
California	826,695	1,060,862	876,166	469,028	430,210	1,600,000
Colorado[a]	1,494,000	1,152,652	2,013,125	1,146,460	409,306	2,012,027
Idaho	....	....	46,667	40,381	50,000	....
Michigan	56,982,765	59,702,404	69,353,202	72,148,172	79,890,798	75,471,890
Montana	9,058,284	24,664,346	43,093,054	67,797,864	57,611,621	78,699,677
New Mexico	869,498	823,511	59,450	79,839	558,385	283,664
Nevada	350,000	288,077	100,000	8,871	50,000	....
Oregon	....	....	....	....	....	....
South Dakota	....	....	....	....	....	....
Utah	605,880	341,885	265,526	126,199	500,000	2,500,000
Washington	....	....	....	....	....	....
Wyoming	100,000	962,468	....	....	....	....
Eastern States	1,555,000	612,124	914,423	211,602	315,719	200,000
Southern States	400,000	395,175	317,711	40,199	29,811	....
Middle States	294,695	324,706	232,114	190,641	....	....
Lead desilverizers and unapportioned	125,000	782,880	950,870	910,144	1,282,496	2,432,804
Total	90,646,232	115,526,053	144,946,653	165,875,766	156,735,381	180,920,524

State.	1888.	1889.	1890.	1891.	1892.
Alaska	....	....	....	....	....
Arizona	31,797,300	31,586,185	34,796,689	39,873,279	38,436,099
California	1,570,021	151,505	23,347	3,397,405	2,980,944
Colorado[a]	1,621,100	1,170,053	3,585,691	6,336,878	7,593,674
Idaho	50,000	156,490	87,243	146,825	226,000
Michigan	86,472,034	88,175,675	101,410,277	114,222,709	123,198,460
Montana	97,897,968	98,222,444	112,980,896	112,063,320	163,206,128
New Mexico	1,631,271	3,686,137	850,034	1,233,197	1,188,796
Nevada	50,000	26,420	....	....	....
Oregon	....	....	....	....	....
South Dakota	....	....	....	....	....
Utah	2,131,047	65,467	1,006,636	1,562,098	2,209,428
Washington	....	....	....	....	....
Wyoming	232,819	100,000	....	....	....
Eastern States	271,631	72,000	....	....	467,488
Southern States	18,201	18,144	378,840	296,463	
Middle States	....	....			
Lead desilverizers and unapportioned	2,618,074	3,345,442	4,643,439	4,989,590	5,491,702
Total	226,361,466	226,775,962	259,763,092	284,121,764	344,998,679

State.	1893.	1894.	1895.	1896.	1897.
Alaska	....	....	....	....	....
Arizona	43,902,824	44,514,894	47,953,553	72,934,927	81,530,735
California	239,682	120,000	218,332	690,237	11,987,772
Colorado[a]	7,695,826	6,481,413	6,079,243	6,022,176	11,873,033
Idaho	36,367	....	1,425,914	....	183,277
Michigan	112,605,078	114,308,870	129,330,749	143,524,069	145,282,059
Montana	155,209,133	183,072,756	190,172,150	221,918,179	230,288,141
New Mexico	280,742	31,884	143,719	2,701,664	701,892
Nevada	20,000	....	....	....	....
Oregon	....	....	....	....	....
South Dakota	....	....	....	....	2,440,338
Utah	1,135,330	1,147,570	2,184,708	3,502,012	3,919,010
Washington	39,875	....	....	....	....
Wyoming	....	....	....	....	....
Eastern States	732,793	2,374,514	3,105,036	4,704,993	4,472,017
Southern States					
Middle States					
Lead desilverizers and unapportioned	7,456,838	2,136,473	....	4,063,173	[b] 1,400,000
Total	329,354,398	354,188,374	380,613,404	460,061,430	494,078,274

[a] For several of the early years the production credited to Colorado includes the yield from some ores of uncertain origin which were smelted in Colorado plants.

[b] Based partly on estimates.

Production of copper in the United States, 1882–1907, by States, in pounds—Con.

State.	1898.	1899.	1900.	1901.	1902.
Alaska					
Arizona	111,158,246	133,054,860	118,317,764	130,778,611	119,944,944
California	16,925,634	26,221,897	28,511,225	33,667,456	25,038,724
Colorado [a]	16,274,561	11,643,608	7,826,949	9,801,783	8,422,030
Idaho	1,266,920	110,000	290,162	480,511	227,500
Michigan	158,491,703	147,400,338	145,461,498	156,289,481	170,609,228
Montana	206,173,157	225,126,855	270,738,489	229,870,415	288,903,820
New Mexico	1,592,371	3,935,441	4,169,400	9,629,884	6,614,961
Nevada	437,396	556,755	407,535	593,608	164,301
Oregon					
South Dakota	1,261,393	17,020	15,147	753,510	445,663
Utah	3,750,000	9,584,746	18,354,726	20,116,979	23,939,901
Washington					209,297
Wyoming	233,044	3,104,827	4,203,776	2,698,712	889,228
Eastern States Southern States Middle States	5,395,226	4,410,554	4,820,495	6,860,039	13,599,047
Lead desilverizers and unapportioned	3,553,336	[b] 3,500,000	[b] 3,000,000	531,530	[b] 500,000
Total	526,512,987	568,666,921	606,117,166	602,072,519	659,508,644

State.	1903.	1904.	1905.	1906.	1907.
Alaska	1,339,590	2,043,586	4,900,866	8,665,646	7,034,763
Arizona	147,648,271	191,602,958	226,854,461	262,566,103	256,778,437
California	17,776,756	28,529,023	16,697,489	28,153,202	33,696,602
Colorado	4,158,368	9,506,944	9,404,830	7,427,253	13,998,496
Idaho	778,906	2,158,858	7,321,585	8,578,046	9,707,299
Michigan	192,400,577	208,309,130	230,287,992	229,695,730	219,131,503
Montana	272,555,854	298,314,804	314,750,582	294,701,252	224,263,789
New Mexico	7,300,832	5,368,666	5,334,192	7,099,842	10,140,140
Nevada	[b] 150,000		413,292	1,090,635	1,998,164
Oregon			846,615	545,859	518,694
South Dakota	173,202	[b] 100,000	38		
Utah	38,302,602	47,062,889	54,083,506	50,329,119	66,418,370
Washington	80,758	663,694	223,328	290,823	122,263
Wyoming	1,023,189	3,565,629	2,530,531	106,177	3,026,004
Eastern States	13,855,612	15,211,086	15,134,192	21,438	696,102
Southern States				18,460,210	20,166,822
Middle States				54,347	[c] 1,299,043
Lead desilverizers and unapportioned	[b] 500,000	[b] 100,000			
Total	698,044,517	812,537,267	888,784,267	917,805,682	868,996,491

[a] For several of the early years the production credited to Colorado includes the yield from some ores of uncertain origin which were smelted in Colorado plants.

[b] Based partly on estimates.

[c] Includes "unapportioned."

TONNAGE AND YIELD OF ORE SMELTED.

TONNAGE.

The copper of domestic origin turned out by the smelters in 1907 was derived from approximately [a] 21,403,000 tons of material treated. This tonnage represents the quantity of ore which reached the copper smelters during the year either directly in crude smelting ore or indirectly—for example, in the form of concentrates—and includes about 258,000 tons of reworked material such as old slags, smelter cleanings, etc. It also includes a considerable quantity of ore which was not mined expressly for its copper content. This class of ores, in which copper is of subordinate importance, comprises dry or siliceous gold and silver ores, which were handled mainly in pyrite smelting and for converter linings; lead ores carrying sufficient copper to make its recovery profitable; cupriferous zinc ores and pyritic sulphur ores, the "cinders" of which are subsequently smelted for copper; and ores mechanically concentrated for values other than copper. Ores of this class can not be separated sharply from distinctly copper ores, and their quantity can be placed only approximately at 892,000 tons. The common fluxing materials devoid of the precious and semiprecious metals are, of course, not included.

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[a] The accuracy of the statistics in this section is lessened by the fact that one important custom-smelting company declined to furnish full data regarding its tonnage. The tonnage treated by it has been ascertained in large degree from its customers, but since the data are not exact, the quantities are mostly expressed in round numbers.

In the table which follows, the first two columns of figures show the quantity and source of all cupriferous material of domestic origin from which the copper production for the year was derived at the smelters. With crude smelting ore is included the tonnage of old slag, etc., that was re-treated. The concentrates include a small quantity of cement copper precipitated from solution. The last two columns show the tonnage of distinctly copper-bearing material shipped or treated by the mines during the year. The third column, headed "Copper ore," comprises both the milling ores and those that were smelted direct, but includes only ore in which the copper recovered or paid for amounted to at least 2½ per cent, except in cases where, although present in less quantity than 2½ per cent, copper constituted the principal value in the ore. Old slag, etc., is similarly included in this column. The fourth column contains those complex ores in which an essential part of the value is in copper. These last two columns practically exclude those ores from which copper was recovered at the smelters in the course of treatment primarily for other metals.

Tonnage of domestic copper-bearing material treated in 1907, in short tons.

Source.	Tonnage smelted yielding copper.		Copper-bearing ore sold or treated by the mines.	
	Crude smelting ore.	Concentrates.	Copper ore.	Copper-lead and copper-lead-zinc ore.
Alaska	90,849	....	98,927	....
Arizona	1,768,256	247,073	3,191,125	1,608
California	417,005	273	339,152	40
Colorado	326,314	65,547	22,619	7,841
Idaho	83,801	683	136,327	....
Michigan	....	172,000	9,892,214	....
Montana	590,827	1,246,160	3,719,600	28,295
Nevada	83,750	291	11,100	31,077
New Mexico	81,013	4,250	164,849	....
North Carolina	7,865	328	11,261	....
Oregon	6,518	298	7,060	....
Tennessee	557,950	....	558,487	....
Utah	1,061,708	121,042	1,793,084	2,920
Washington	17,317	7	14,691	....
Wyoming	[a]17,000	[a]1,000	[a]26,071	....
Alabama, Georgia, Maryland, Missouri, Vermont, Virginia, and unapportioned	4,369	2,720	52,917	....
Total	5,107,542	1,862,665	20,039,484	71,781
Grand total	6,970,207		20,111,265	

[a] Partly estimated.

Of the total tonnage smelted, approximately 5,107,500 tons, or about 24 per cent, were of sufficient richness or of such favorable metallurgical character as to be smelted without concentration. The remaining 16,295,500 tons were concentrating ores, from which were produced about 1,862,700 tons of concentrates, the average concentration being slightly under 9 into 1. If the immense tonnage of milling ores of Michigan is excluded, the concentrating ores of the rest of the country exceeded the smelting ores by only a little over 1,000,000 tons. Included with the concentrating ores is a small tonnage from which the copper was extracted by leaching processes. A small quantity of copper was procured without the mining of any ore by the treatment of mine waters. In both cases the copper was recovered from solution by replacement of iron scrap, and the resulting "precipitate," or cement copper, which may be regarded as high-grade concentrate, went into the smelters. Of the 892,000 tons of ore treated primarily for other values than copper, about 382,000 tons were smelted direct and about 510,000 tons were concentrated, producing approximately 42,500 tons of concentrates.

Excluding the 258,000 tons of secondary material, the total tonnage of metalliferous materials of domestic origin from primary sources charged into copper-smelting furnaces in 1907 amounted to approximately 6,712,200 tons, about 28 per cent being concentrates and the remaining 72 per cent, or 4,849,500 tons, being smelting ore. Canadian and Mexican smelters treated 93,536 tons of this ore, from which was returned in the form of matte the content of 35,363 tons. Almost 6,000 tons of domestic matte was also treated in these foreign works. On the other hand, reduction plants in this country smelted a considerable import tonnage of foreign origin, the approximate figures being—ore, 349,280 tons; concentrates, 67,550 tons, and matte, 56,270 tons, a total foreign tonnage of about 473,100.

The total metal-bearing charge treated by copper smelters in the United States in 1907 was about 7,098,800 tons, exclusive of material rehandled. This rehandled material includes the following: (1) The conversion into blister of approximately 142,624 tons of custom matte, all of domestic origin—part of this matte was of so low a tenor that it had to be resmelted to a higher grade before conversion; (2) about 258,000 tons of old slags, smelter cleanings, etc., material discarded or lost in former operations.

Excluding the tonnage of old slags, etc., and of ores from which the recovery of copper was incidental, it appears that the tonnage of essentially copper ore of domestic origin treated at the smelters either as crude ore or in concentrates was about 20,253,000 tons.

Among the principal copper-ore producing States Michigan is far in the lead, having extracted her copper in 1907 from about 9,970,000 tons of ore; Montana is second in total copper-ore tonnage, with considerably less than half as much; Arizona is third, Utah fourth, Tennessee fifth, and California sixth. Arizona leads in tonnage of crude smelting ore. Utah ranks next, and Montana, Tennessee, and California follow in order. Michigan produces no smelting ore, the comparatively small tonnage of mass and barrel copper smelted without concentration scarcely falling within this category. Montana is far in the lead as to tonnage of cupriferous concentrates smelted during the year; Arizona, Michigan, and Utah are much lower. California produced practically no copper concentrates (except a small tonnage of "cement" copper), and Tennessee none whatever.

YIELD.

If there is excluded from the total copper production the quantity derived from old slags, furnace linings, etc., which was about 10,480,000 pounds, and the quantity derived incidentally to the recovery of other metals, which is estimated at about 3,100,000 pounds, the remaining copper production, approximately 855,420,000 pounds, was derived from about 20,253,000 tons of ore, mined principally for copper. The average yield of this ore was therefore about 42.2 pounds per ton, or 2.11 per cent. The native copper ores of Michigan, which in 1907 yielded only 1.10 per cent, being excluded, the remaining copper ores of the country, about 10,283,000 tons, yielded about 636,289,000 pounds of copper, an average of about 62 pounds per ton, or 3.10 per cent.

The 5,107,500 tons of crude smelting material yielded 408,986,600 pounds of copper, or about 47 per cent of the total production, an average of 80.1 pounds per ton, or 4.05 per cent. The 1,862,700 tons of concentrates yielded the remaining 53 per cent, or 461,009,900 pounds of copper, with an average yield of 247 pounds per ton, or 12.35 per cent for the concentrates, or an average of 28.2 pounds per ton, or 1.41 per cent for the concentrating ore. Excluding the high-grade concentrates from the low-grade ores of Michigan, the yield for the remaining materials was: Concentrates, 149 pounds per ton, or 7.5 per cent; concentrating ore, 38.2 pounds per ton, or 1.91 per cent. From custom matte converted in 1907 about 75,885,730 pounds of domestic copper was produced, the yield from the matte being about 26.6 per cent.

The foreign ores imported for smelting in this country were, considering the more costly transportation, necessarily of higher grade than the average of domestic ores. Actual figures can not be given, as only the figures for the combined yield of foreign ore, concentrates, and matte are available.

Copper ores yielded 272,150 ounces of gold and 13,955,436 ounces of silver, according to mine reports for 1907.[a] This is an average yield for the 20,039,484 tons of copper ores of about 0.0135 ounce of gold and 0.609 ounce of silver per ton. If the Michigan ores that do not carry silver, amounting to about 8,000,000 tons, are excluded from this calculation, the copper ores which actually contained precious metals yielded an average of about 0.022 ounce of gold and 1.15 ounces of silver per ton.

Pyrite smelting, which has grown rapidly in recent years, owing not only to metallurgical advances, but to the marked increase in mining of pyritic copper ores, offers, because of its high requirement of silica flux, an advantageous method of treatment for those siliceous gold and silver ores which require or permit smelting. Copper is thus fast replacing lead as a collector of the precious metals in the smelting of dry ores. In consequence, the gold and silver product of all domestic ores treated in copper smelters was considerably in excess of the yield from the copper ores alone.

All this gold and silver was recovered as such only on electrolytic refining of the pig copper.[b] A large part of the output of the Morenci-Metcalf district in Arizona and of the Ducktown district of Tennessee, and small quantities from the Globe district of Arizona, and from California, New Mexico, Missouri, and Wyoming, are too low in precious metals to make the electrolytic refining of this copper profitable. With these exceptions, practically all the blister copper of the country, as well as a noteworthy portion (over 16 per cent) of Lake copper, is subjected to this separation by electrolysis. In all, about 630,000,000 pounds of domestic copper carrying gold and silver and requiring electrolytic refining were produced in 1907.

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[a] See "Production of Gold and Silver in 1907."

[b] An exception is the small quantity of silver obtained in Michigan as "pickings"—the sorting out of the "nuggets" and "half-breeds" which accompany the native copper.

CONDITIONS OF PRODUCTION BY STATES.

The general trade conditions under which the copper-producing industry of the United States was carried on during the year 1907 have been outlined on preceding pages. In the review which follows of the industry in each State, the principal features affecting production are given in the case of those whose output is of importance. Statements of the known resources of the various districts are presented, but deductions are not drawn. The purely financial affairs of copper companies are not discussed. Those who desire to gain specific information of the detailed operations of any company, or of the mine output proper, as distinguished from the actual production of metal, are referred to the reports on mine production for the various States, which have been published by the United States Geological Survey and which, with this and other reports, form a part of the general volume, "Mineral Resources of the United States, 1907."

ALASKA.

The blister-copper production of Alaska in 1907 was 7,034,763 pounds, as compared with 8,685,646 pounds in 1906. The falling off is due almost entirely to the fact that the low price of copper, coupled with unstable financial conditions, caused operations at most of the mines to be suspended in the fall of 1907. Had work continued throughout the year, the production would undoubtedly have exceeded that of 1906. The difference between mine output and smelter output, as shown on page 18, is partly due to the fact that stock piles at the Alaska Smelting and Refining Company's works were wholly cleaned up when the plant was closed in the fall of 1907.

The principal production came, as in former years, from the Ketchikan district of southeastern Alaska, which is credited with a blister output of about 5,400,000 pounds. The two smelters in Alaska are situated in this region, but the plant of the Alaska Copper Company has not been operated since 1906. Matte and ore from this region went to Tacoma, and considerable ore also went to plants in British Columbia. The ores of this district are mostly heavy sulphide ores of contact-metamorphic origin. Pyrrhotite and plentiful magnetite and pyrite accompany the chalcopyrite, the ore running high in iron. The grade of the ore is not high, the yield of copper being, as a rule, not much over 3 per cent. Precious-metal values are low. Supplies are costly, and wages are high. The deposits have been described in some detail in publications of the United States Geological Survey.[a]

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[a] Wright, C. W., Bull. U. S. Geol. Survey No. 284, 1906, pp. 50–53; Bull. U. S. Geol. Survey No. 314, 1907, pp. 65–72; Bull. U. S. Geol. Survey No. 345, 1908, pp. 94–96. Also Wright, C. W., and Paige, Sidney, Bull. U. S. Geol. Survey No. 345, 1908, pp. 98–115.

The second producing copper district of Alaska is in the Prince William Sound region. The principal production in 1907 came from Latouche Island and from Ellamar, near Valdez. All the ore went to the Tacoma smelter. The ore, which is chalcopyrite more or less disseminated through metamorphosed country rocks[a] has to carry a fairly high percentage of copper in order to stand the cost of shipment.

No production was made in 1907 from the Copper River country. Situated at a distance from the coast and difficult of access, deposits in this region have necessarily been developed slowly. By far the most important deposit, and, in fact, about the only one whose importance is as yet proved, is the Bonanza mine of the Kennicott Mines Company, situated near the Chitina River. This deposit is a great mass of solid chalcocite in limestone, and averages over 60 per cent copper and about 22 ounces silver per ton. The deposit is situated near the top of a steep slope and much similar ore is found in the talus on this slope. Mr. F. H. Moffit, of the United States Geological Survey, estimates that at least 100,000,000 pounds of copper can be extracted from this deposit, derived about equally from the massive body and from the talus. Estimates of the company are still higher, principally regarding the quantity in the talus. The mine is about 160 miles from the coast by the nearest practicable route. An aerial tramway will deliver the ore to the side of Kennicott Glacier, whence it will be carried a few miles by rail to the head of practical navigation on the Chitina River. Light-draft boats will carry it down the Chitina and Copper rivers about 100 miles to the head of Abercrombie Rapids, from which point it will again go by rail to the coast at Cordova Bay. Construction on the various sections of this transportation system was carried on actively in the summer of 1908, but it is expected that important shipments of ore can not be made before 1910. Descriptions of the region will be found in reports of the United States Geological Survey.[b]

ARIZONA.

In 1907 Arizona produced 256,778,437 pounds of blister copper, a relatively small decrease from the production of 1906, which was 262,566,103 pounds. In consequence of the greatly reduced output of Montana, Arizona took the first rank in 1907 among the copper-producing States. The decline in production was due entirely to the low market and the bad financial conditions of the latter part of the year, and had operations been maintained at the rate of the first eight months of the year, the production would probably have exceeded that of 1906 by several million pounds. The small difference between mine and smelter production is due mainly to the fact that in 1906 the mines shipped to the smelters a little more than was handled by these works, and this excess was partly worked off during 1907. There was also a quantity of material smelted during the year at El Paso, which had been mined and shipped in 1905 to the old Val Verde smelter, but had not been smelted before that plant was burned.

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[a] Grant, U. S., Bull. U. S. Geol. Survey No. 284, 1906, pp. 78–87. Moffit, F. H., Bull. U. S. Geol. Survey No. 345, 1908, pp. 176–178.

[b] Schrader, F. C., and Spencer, A. C., Geological Survey special publication, 1901; Mendenhall, W. C., Prof. Paper, U. S. Geol. Survey No. 41, 1906; Moffit, F. H., and Maddren, A. G., Bull. U. S. Geol. Survey No. 345, 1908, pp. 127–175.

Many districts contributed to the output in 1907, but the great bulk of the production was derived, as in former years, from four important camps. Arizona is thus distinguished from the two great producing States, Montana and Michigan, which have but one important district each.

Bisbee district.—The Bisbee or Warren district, in Cochise County, the third largest district in the country and the largest in Arizona, made a blister-copper production of about 110,000,000 pounds, as compared with about 131,000,000 pounds in 1906. The output would have been larger had it not been for the reduced scale of operations during the last three months of the year. As in previous years, the production was derived almost entirely from the Copper Queen, Calumet and Arizona, Superior and Pittsburg, and Shattuck-Arizona mines.

The primary ore of this district, which consists of pyrite with chalcopyrite, and possibly bornite, replaces limestone near an intrusive body of granite porphyry, and is now commonly regarded as the result of a modified sort of contact metamorphism. The copper of these primary ores has been in part concentrated by the process known as " secondary enrichment " into workable ore bodies of varying size and of irregular shape.

The tops of most of the Bisbee ore bodies lie at some distance below the surface, and the ores are in many places underlain by practically barren limestone instead of primary ore. In other words, secondary enrichment has in some places extended to the very bottom of the ore bodies. Oxidation, also, has extended to unusual depth. The ores consist mainly of carbonates, oxides, chalcocite, chalcopyrite, and pyrite, all being in places more or less intimately mixed. Native copper is present also in many localities and in some stopes has been very abundant.[a] As nearly as can be learned between 35 and 50 per cent of the copper mined in 1907 was contained in the sulphides, chiefly chalcocite, and practically the whole of the remainder was carried by the oxidized minerals. The percentage of sulphide ore mined is increasing.

If the total production since the discovery of the district is taken into account, Bisbee is undoubtedly the richest of the great copper camps of the country. The ore mined to date is estimated to have yielded 8 per cent copper. The yield in recent years has been somewhat below that average, and fell somewhat lower in 1907. The Calumet and Arizona ore, as stated in the annual report of the company, yielded 5.85 per cent in 1907, compared with 7.95 per cent in 1906, based on the tonnage as mined. The corresponding yield from Superior and Pittsburg ores was 3.69 per cent in 1907 and 4.099 per cent in 1906. All the ore mined in the district is rich enough to smelt, and no concentration is practiced. The ores contain rather low values in gold and silver. In 1907 the yield of gold and silver per ton of copper was $13.74 for the Calumet and Arizona Company and $6.90 for the Superior and Pittsburg Company.

The locus of the principal known ore bodies has been shown to be a great flat-lying shoot of variable thickness and as yet undetermined extent, pitching gently toward the southeast approximately with the bedding of the limestones. Probably the most important feature of the year was the development on the lower levels of Calumet and Arizona workings of bodies of pyrite, chalcopyrite, and bornite ore, little enriched and carrying good copper values. This discovery strengthens the possibility of the existence of other important ore horizons underlying the one already developed and at such depth as to be mainly or wholly below the zone of secondary enrichment.

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[a] See Ransome, F. L., Prof. Paper U. S. Geol. Survey No. 21, 1904, for description of Bisbee ore deposits.

The ore bodies worked at present lie mostly between depths of 400 and 1,400 feet, the ore being deeper toward the southeast. The known ore bodies near the surface are practically exhausted. All development is carried on by means of vertical shafts, none of which has as yet been sunk far below the horizon of known ore bodies. Water has given considerable trouble in the sinking of the deep shafts in the southern part of the camp, but when a block of ground is once drained only light pumping is required. The square set and filling system is mainly employed, and the high price of timber constitutes an important part of the cost of mining. Underground haulage is now being done in part by electricity. Wages are also high, but transportation charges are not excessive, owing to service by the El Paso and Southwestern Railroad, a line controlled by Phelps, Dodge & Co. Spurs extend to the principal producing shafts. Power is furnished jointly by coal and oil fuel and is reasonably cheap for that part of the country. Owing in large measure to the good grade of the ores the cost of producing copper is relatively low.

The older mines are developed well ahead of production. Enlargement of the Calumet and Arizona smelters at Douglas was begun in 1907. The Copper Queen smelter, the second largest in the country, handled in 1907 more crude smelting ore than any other copper smelter. This plant does a custom business, drawing ores from Mexico, New Mexico, and other Arizona camps, as well as custom ore from Bisbee. The smelters were seriously handicapped in the early part of the year by lack of fuel, especially of oil.

The Bisbee ores are of wide range in composition, but when mixed and bedded on the immense scale possible they are virtually self-fluxing and are smelted economically. During the year a considerable tonnage of slag from the site of the old Copper Queen black-copper smelter at Bisbee was shipped to the Douglas plant and re-treated Some sulphide ore from this district was treated by the Old Dominion smelter at Globe.

Morenci district.—The copper district at Morenci and Metcalf, in Graham County, produced blister containing about 63,000,000 pounds of copper, compared with a production of about 56,000,000 pounds in 1906. The greater part of the production came from the mines and smelters of the Arizona, Detroit, and Shannon companies. With the exception of some of the ores of Shannon Mountain, the old shallow bodies of high-grade oxidized ore derived from contact-metamorphic replacements of limestone have been exhausted. A great part of the production came from large disseminated bodies and stockworks of chalcocite along shattered zones in altered porphyry. The profitable ores change in depth to lean pyritic ores of similar distribution, which affirm the secondary character of the chalcocite.[a]

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[a] For a description of the ore deposits see Lindgren, W., Prof. Paper U. S. Geol. Survey No. 43, 1905.

The bulk of the ores are of low tenor in copper; nearly 90 per cent of them are milled with a concentration of about 6 into 1. The average yield of blister copper from these concentrating ores was slightly over 2 per cent in 1907. The smelting ores, which include the richer chalcocite ores and the oxidized ores mined by the Shannon company, gave a yield of about 5 per cent. The content in gold and silver is very low, the blister copper produced carrying on the average not over $3 per ton. Such blister as is sufficiently pure, therefore, is either transformed into casting copper without electrolytic refining or is exported unrefined and consumed direct.

Few profitable ore bodies occur at a greater depth than 400 feet. A notable exception is furnished by the Coronado mine, where the ore occupies a fault fissure and has been developed to a depth of about 1,000 feet. The rugged topography allows the extraction of a great part of the ores by tunnels, shafts being used somewhat at Morenci and open cuts on Shannon Mountain. Square setting and filling is the chief method employed in the stopes, but the amount of timber per ton of ore is lower than is commonly required by that system. The filling of stopes by flushing in of mill tailings is practiced by the Arizona Copper Company. The mines are practically dry. Most of the power has been derived from producer gas, but coal and oil are now being used to a greater extent. The district is connected with outside transportation by the Arizona and New Mexico Railroad, owned by the Arizona Copper Company. Local transportation is effected by narrow-gauge lines and inclined tramways. Water supply is an important item of expense, as it is necessary to pump from San Francisco River, 1,500 feet below Morenci. Mexican labor is employed to a large extent and commands half the wages paid to Americans.

Although this is the oldest important copper camp of Arizona, the reserves of concentrating ore in the district are still large. As distinguished from Bisbee and Jerome, where all the ores are of smelting grade, the output of the Morenci district is dependent on the capacity of its concentrating mills. The 3 smelters handled during 1907 about 348,000 tons of copper-bearing material representing over 1,400,000 tons of ore mined. Of this quantity, about 154,000 tons were smelting ore and 194,000 tons concentrates. In addition, one of the smelters at Clifton treated some custom ore from outside the district and concentrates from New Mexico. The Arizona Copper Company produced no bluestone from its leaching plant during the year. While the converting plant of the Detroit Copper Company was being completed in the early part of the year, the matte produced, which was of high grade, like all the matte of the district, was shipped to the Copper Queen smelter for conversion. Considerable slag from old dumps of the Detroit smelter was reworked.

Globe district.—The old silver camp of Globe, in Gila County, produced approximately 35,000,000 pounds of blister copper in 1907 as against about 27,000,000 pounds in 1906. This output was derived chiefly from the Old Dominion and United Globe mines, but the outlying mines produced more in the aggregate than ever before, and the Arizona Commercial, nearer the larger mines, was also a producer.

The main productive area contains blocks of sedimentary rocks floated up and partly surrounded by an intrusive mass of diabase.

The ore bodies[a] are of two great classes—irregular replacements in the sediments and fault lodes or fissure zones in the diabase. The original ores in limestone are believed to have been of contact-metamorphic origin. Practically all the ores have been secondarily enriched. The workable ore in the limestone occurs, somewhat as at Bisbee, in irregular bodies at the base of great masses of mixed limonite and specularite. In the quartzite native copper and cuprite predominate. The chalcocite ores are for the most part enrichments of pyritic veins and disseminations in the crushed and altered diabase. This lean pyritic material has been reached at a depth of about 800 feet, but at certain local places cross fractures have allowed the enriching solutions to extend to greater depth. The richest body of this secondary ore has been developed to the sixteenth level, or about 1,200 feet from the surface. In the United Globe mines bodies of primary pyritic ore rich enough to be worked are sometimes found. A very important development was the opening by the Miami Copper Company, near Globe, of a low-grade deposit of the well-known type, consisting of disseminated secondary sulphides in schist. The company estimates 4,200,000 tons developed and 2,200,000 tons of probable ore in addition, with good prospect of increasing this tonnage. The average content is placed at not less than 2.9 per cent, and the recovery of refined copper at 2.1 per cent. It is estimated that in all probability a total of at least 250,000,000 pounds of copper can be taken from the mine as at present developed at a cost of 9 cents per pound. A 1,000-ton mill is to be erected and the concentrates will probably be smelted at the Old Dominion works.

The Globe ores have long been known to be of high grade, and the outlying mines are still shipping ores of an average content considerably over 5 per cent. But the increase in quantity of lower-grade concentrating ores in the United Globe and Old Dominion mines has lowered the tenor for the district, so that the average yield from all the ores in 1907 was a little over 4 per cent. A little more than one-third of the approximately 445,000 tons of ore treated in 1907 was concentrated, on an average about 3.5 into 1. Fully 60 per cent of the 1907 output was derived from sulphur-bearing ores, chiefly chalcocite. Ore of this class will undoubtedly soon become the principal ore of the district. The greater part of the ore from the outlying mines is oxidized and much of it consists chiefly of chrysocolla. Leaching processes have been tried but not found successful. The gold and silver contents of the ore are very low, and the average yield per pound of copper is only about 0.5 cent. Part of the copper is therefore transformed without electrolysis into casting copper.

Most of the workings are not deep; the deepest shaft in the camp goes down about 1,200 feet. Tunnels are of service only in the upper workings. Square-set stoping predominates, but stulls have been employed in the flat stopes in quartzite. The bottom of the Old Dominion mine is exceedingly wet, and the pumping plant has been enlarged to a capacity of 6,000,000 gallons per day. Owing in part to the wetness of the ground, the kaolinized sulphide ore in the lower levels is difficult ground to hold. Transportation to the Old Dominion smelter is furnished by a branch of the Southern Pacific and by local private lines. Oil is the principal fuel. Mexican labor is employed in part.

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[a] Ransome, F. L., Prof. Paper U. S. Geol. Survey No. 12, 1902.

Globe ores have long been at a disadvantage because of their high silica and lack of sulphur. It has been necessary to bring in outside sulphides, and favorable smelting charges by the local works have been impossible on much of the oxidized siliceous ore from mines in the district. Bisbee, Ariz., and Nacozari, Mexico, supplied sulphide ores in 1907, while considerable siliceous ore from the district went to the Douglas, El Paso, and Cananea smelters, chiefly for converter lining. By the middle of 1907, however, the quantity of sulphide ores from the Old Dominion and United Globe mines was about sufficient to give proper results in the furnaces, and importations have now practically ceased. Some old slag was resmelted at the Old Dominion plant. A little material from New Mexico and from California was also treated at this smelter in 1907.

Jerome district.—The production of blister copper in the Jerome district of Yavapai County in 1907 was about 33,000,000 pounds. The decrease in production from that of 1906, which was about 38,500,000 pounds, is due to curtailed output during the last three months of the year by the United Verde Copper Company, which is responsible for practically the entire output of the district.

The United Verde ore body occupies a zone of shearing so intense that the containing rock, a rather basic porphyry, has here been converted into a schist. Pyrite, chalcopyrite, and some zinc blende, with varying amounts of quartz, have in places partially or completely replaced this schist, and in other places the schist is injected by veinlets and stringers of sulphides and others of quartz. As a rule the more massive sulphide ore contains more iron and zinc, while that consisting of alternating bands of sulphide and schist—the so-called "slaty" ore—carries a much higher proportion of chalcopyrite. The ores are undoubtedly of pre-Cambrian age, like the inclosing rocks, and are wholly independent of the Devonian sediments which almost overlie the deposit. Almost the entire output in 1907 came from sulphide ores, but a little oxidized ore, rather high in gold, added to the production. The ores mined are all of smelting grade and carry a high percentage of copper, the average yield in 1907 having been considerably above that of the Bisbee camp and much higher than that of the other large pyritic deposits of Bingham, Utah, Shasta County, Cal., and Ducktown, Tenn. The content of the ores in gold and silver is decidedly higher than in any other of the large Arizona copper camps and far above the precious-metal yield of the pyrrhotite ores of Ducktown, although not very different from that of the Bingham and Shasta County ores.

So far as present developments have shown, the ore body is an irregular, rudely lenticular mass of large dimensions. The surface outcrop of the lens was about 800 feet long. The shoot pitches northward and undoubtedly extends along the pitch beyond and below the region explored to date.

Extraction is effected through shafts, although there is a tunnel reaching the 500-foot level, and a new tunnel is being driven in to strike the lowest level of the new 1,000-foot shaft. Motor haulage is used on the principal levels. Square setting is employed only where absolutely necessary, and the use of timber is avoided as much as possible, owing to danger from fires. Native round timber is the kind most used. The system now prevailing is overhead stoping with horizontal back, and filling kept up within working distance. Work is carried on in certain portions of the "fire country" by the employment of the plenum air-pressure system originated at Iron Mountain, Cal. The developed workings are not very wet, but considerable surface water finds its way into the mine through the caved ground, and, passing through the burning stopes, takes up copper and sulphuric acid. An extensive system of flumes allows the precipitation of most of this copper. The district is served by a narrow-gauge line owned by the company, which connects with the Santa Fe, Prescott and Phoenix Railway. Oil is the principal fuel. European labor is extensively employed, but the wages are high, the daily pay for work in the "fire country" being $4.

All the higher sulphur ores are roasted before smelting, the claim being made that the ores carry too high alumina to make pyrite smelting successful. The highest-grade ores are lower in sulphur and are smelted direct. It is an interesting fact that ore extracted from stopes which had been on fire for several years is oxidized only slightly, and not at all except along fractures. Limestone flux is quarried along the railroad near the mine. Siliceous material is encountered in the workings in sufficient quantity to supply converter lining. The coke, which averages 10 per cent of the charge, is from Colorado. The settling of ground under and around the smelter appears to have ceased, and a new 20-foot furnace was added in 1907.

The ground considered as ore reserves in 1902 was lost to immediate availability by the fire and the attendant caving. These stopes are now gradually being reclaimed, but most of the ore now being mined comes from stopes that were unknown three years ago.

A number of other companies in the Jerome district were more or less actively engaged in exploration in 1907, but no important deposit has yet been developed.

Silverbell district.—The blister copper produced from ores of the Silverbell district in Pima County amounted in 1907 to about 5,400,000 pounds, a distinct increase over the output of 1906. The principal producer is the Imperial Copper Company, which mines a deposit in altered limestone near a porphyry mass. The ore occurs in garnet gangue, and consists of pyrite, molybdenite, and chalcopyrite. Practically all the ore mined at present is sulphide and comes from a maximum depth of about 800 feet. Considerable water is encountered. Production has been derived from ores shipped to Douglas, which average 5 to 6 per cent copper and about 1.5 ounces silver. A 350-ton smelter at Sasco and a 300-ton concentrating mill near the mines, completed in 1908, will permit the working of lower-grade ores, and the production may be expected to increase. A new branch line connects the mine with the smelter, which is situated on the Southern Pacific.

Other districts.—The Saddle Mountain Company, at Christmas, Gila County, turned out considerable matte from its deposit of garnetized limestone carrying copper minerals. The matte was converted at the Humboldt smelter of the Consolidated Arizona Smelting Company, but in the fall both these plants closed down. The Helvetia Copper Company, at Helvetia, in Pima County, and the Duquesne Mining and

Reduction Company, at Duquesne, Santa Cruz County, operated matting plants for a part of the year and shipped crude ore for the remainder of the time. The smelter at Humboldt, Yavapai County, handled considerable custom ore from that part of the Territory during the time it was in operation. Considerable Arizona ore was treated at El Paso, and some went to California and Mexico.

One of the most important developments outside of the principal districts already mentioned was in the Mineral Creek district of Pinal County, where the Ray Consolidated Copper Company has opened a large disseminated chalcocite body in porphyry. Estimates indicate that about 3,000,000 tons of about 2.4 per cent tenor have already been opened and can be made to produce copper at a cost not in excess of 9 cents per pound. There is a 250-ton mill now on the property, and the company contemplates the erection of a larger one; also of a smelting plant. One matter that is being watched with much interest is the finding of chalcocite ore of good grade in the lowest workings of Tombstone. The importance of this discovery is not yet established.

CALIFORNIA.

General statement.—The production of blister copper in California in 1907 was 33,696,602 pounds; in 1906 the production was 28,153,202 pounds. The bulk of the production and nearly the whole increase was from the Shasta County region. Several other counties contributed to the output, Calaveras County leading. The difference between mine and smelter production, as shown on page 18, is due to the fact that the smelters treated considerable stored ore that had been mined previously.

Shasta County region.—The Shasta County copper region, which lies near Sacramento and Pitt rivers, north of Redding, is the eighth copper district of the country, and in 1907 produced about 28,000,000 pounds of blister copper, as compared with 21,000,000 pounds in 1906. This production came from 3 companies—the Mammoth, the Mountain, and the Great Western. The Bully Hill smelter was being remodeled. The typical ore of the region[a] occurs as large bodies in intensely crushed granitic porphyries and locally in adjoining shales. It is a massive sulphide made up of varying proportions of pyrite and zinc blende with chalcopyrite in comparatively small amount, and ranges from less than 1 to over 8 per cent copper as mined. The secondary zone, which was wonderfully productive of copper and silver at the Iron Mountain and Bully Hill mines has been exhausted, and at the other mines is either of little importance or practically absent.

The ores smelted in 1907 yielded approximately 3 per cent of copper. The yield per ton in gold was about $1.30 and in silver 2.1 ounces, or $1.40, which combined are equivalent to 4.5 cents per pound of copper. In the aggregate several million tons of ore are blocked out in the mines of the Balaklala, the Bully Hill, the Mammoth, the Mountain, and the Trinity companies. The limits of these ore bodies are now pretty well defined, and it is doubtful if new bodies can be discovered as rapidly as the present ones are exhausted. The first large body to be worked in the district, that at Iron Mountain, is now nearly worked out, and in spite of the fire which has been burning for several years practically all the ore will be extracted.

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[a] See Diller, J. S., Geologic Atlas, U. S., folio 138, 1906. Also Bull. U. S. Geol. Survey No. 213, 1903, pp. 123–132, and Bull. No. 225, 1904, pp. 169–179. A report based on detailed investigation of the ore deposits is now in preparation.

Most of the ore bodies thus far discovered are developed by workings not more than 500 feet deep, but the Great Western workings, in the Afterthought district, exceed this depth and in the Bully Hill district the lowest level is about 900 feet below the outcrop. Owing to the rugged topography, tunnels afford easy access to the ore bodies, but in a few places winzes from these tunnels are required. Open cutting is employed in part at the Balaklala and the Afterthought mines. Water is not troublesome. Up to the present time square setting has been chiefly employed. At the Mammoth mine the horizontal slicing system, with subsequent caving, is employed, and the quantity of timber required, which was large at the start, is gradually being lessened. Methods requiring less timber may be employed in the mines that are now in the development stage. Native timber is used. Electric power is employed almost exclusively and is derived from the lines of the Northern California Power Company. Much of the coke comes from Australia. The Southern Pacific Railroad crosses the district. The Iron Mountain and Hornet mines are connected with it by a private railway, and the Mammoth by an aerial tramway, which has been replaced by a combination steam and electric road. An aerial tram connects the Balaklala and Trinity mines with the Balaklala smelter at Coram. The Sacramento Valley and Northeastern Railway was completed to the Bully Hill district early in 1908. Work has been begun on a line to the Afterthought district. European labor is employed chiefly.

Pyrite smelting is now applied almost exclusively to the ores and is very successful. Even the zincky ores of the Afterthought region are handled by the aid of a hot blast. Some experiments are under way to save the zinc now lost at this plant, and some steps in this direction may be undertaken at Bully Hill also. The Mammoth Company was the largest producer of the year, but turned out only matte, which was converted at the United States smelter in the Salt Lake Valley. The construction of converters, as well as of 2 additional blast furnaces, however, was practically completed in 1907. During that year the fine ore was shipped mostly to sulphuric-acid works near San Francisco, where the resulting cinders were smelted for their copper. The Mountain Copper Company, owing to the raising of the injunction against its Keswick plant, treated part of its output at that smelter and part at its works at Martinez, on San Francisco Bay, where it has, in addition to a small electrolytic refinery, a sulphuric-acid and fertilizer plant that utilizes phosphate from Utah and Idaho. The Afterthought smelter shipped its matte to Utah for conversion. Some Shasta County copper ore was treated at the Garfield smelter. The Bully Hill smelter, which had been idle since early in 1906, was enlarged and equipped for pyritic smelting. A reverberatory was also added for the treatment of fines. Work was actively carried on by the Balaklala Company in the construction of its new 1,500-ton smelter until October, when construction was stopped, not to be resumed until 1908. This plant, which will treat the Balaklala and Trinity ores, will make matte, which may be converted at the Mammoth works pending a decision regarding the resumption of construction of the San Bruno smelter.

The smelters that were operated in 1907 treated approximately 296,000 tons of pyritic and siliceous ore from Shasta County. Custom ore was also handled and consisted mostly of dry gold-silver ore from Nevada, with some siliceous copper ore from Idaho; also copper ores from Oregon, from Utah, and from other districts in California.

Other districts.—Among other productive districts in California are the Campo Seco and Copperopolis districts of Calveras County, whose combined production in 1907 was about 4,500,000 pounds. The ores consist of heavy pyrite with chalcopyrite, and occur as lenticular bodies in schist. The average yield in 1907 was somewhat over 5 per cent. Some of the ores carry practically no gold and silver, and the copper, being free from impurities, is made into casting copper. Smelters were operated by the Penn Chemical Company at Campo Seco and by the Union Copper Mining Company at Copperopolis. The matte from both and some cement copper from the leaching plant of the latter were shipped east for further treatment.

A small production from San Bernardino and Inyo counties was treated in part at the Needles smelter, which handled also a little ore from Arizona. The Furnace Creek or Greenwater district of Inyo County made only a slight production. Miscellaneous shipments from California, as well as ore from Nevada, reached the works of the Mountain Copper Company, the American Smelters and Securities Company, and the Peyton Chemical Company. Some of the matte produced is converted in Utah. At the Dairy Farm mine, in Placer County, active development of the large pyritic ore body was suspended when work stopped on the San Bruno smelter, to which this mine was to ship. This smelter, which was being built by the Guggenheim interests, was designed to handle, in addition to Dairy Farm ore and Balaklala matte, siliceous ores from Nevada and possibly some of the chalcocite from Copper River, Alaska. Opposition arising over the smelter smoke prospect caused construction to be stopped in the fall of 1907 and no work has since been done.

COLORADO.

The production of blister copper in Colorado in 1907 from materials originating within the State was 13,998,496 pounds, as compared with 7,427,253 pounds in 1906. The marked difference between reported mine production and actual smelter yield has been noted and explained for previous years. The same explanation undoubtedly applies for 1907, viz, that considerable copper was recovered by the smelters from ores in which copper was present in small quantities and was not paid for; hence the mining companies in their reports to the Geological Survey assumed that no copper was recovered. Another cause for the larger smelter output in 1907 was that in the latter part of the year some of the custom smelters, being unable to secure enough ore to continue in operation, used up practically their entire stock of ore before closing down.

The production for 1907 was derived in large measure from the smelting of ores (and concentrates) which were mined primarily for other metals than copper. As in former years, the Leadville district ranked first in copper production, with a smelter output of about 5,700,000 pounds, followed by the San Juan country, whose production, about 2,600,000 pounds, was derived in part from copper and copper-lead ores. Gilpin, Chaffee, Ouray, and Clear Creek counties contributed smaller amounts and nearly every other mining county in the State produced a little copper.

The few districts in which copper is the chief metal were inactive or produced little in 1907. Principal among these are the deposits at Pearl,[a] in Larimer County; at Cashin,[b] in Montrose County; in southeastern Chaffee County,[c] and in the plateau region[d] of southwestern Colorado, of which short descriptions have been given by members of the United States Geological Survey. The most productive was the Turret district in Chaffee County.

A great part of the copper produced in Colorado was recovered in matte in lead furnaces at the large plants of the American Smelting and Refining Company, and ultimately appeared as electrolytic copper at the refinery at Perth Amboy. Much of it was first converted at Omaha, Nebr., where considerable cupriferous material from other States, especially that rich in gold and silver, was treated. The Ohio and Colorado Company also turned out copper matte from its lead smelter at Salida. Some copper was recovered from the smelting of zinc-ore cinders by the United States Smelting Company, at Canyon, the matte produced being further treated within the State. Some Colorado ore and matte went to the Salt Lake Valley for smelting and converting. The Boston and Colorado smelter near Denver turned out matte which was shipped for conversion. The Ross Mining and Milling Company's smelter at Silverton was in operation for a part of the year, producing matte which was shipped outside of the State for conversion. Other smelters, including those at Pearl, Golden, Grand Junction, and Ironton, were not operated during 1907. Besides handling material originating within the State, the Colorado smelters treated ores, concentrates, or matte from Arizona, Idaho, Nevada, New Mexico, Utah, and Wyoming.

IDAHO.

In 1907 the production of blister copper from Idaho was 9,707,299 pounds, whereas the production in 1906 was 8,578,046 pounds. The difference between mine and smelter production in 1907 is due to the fact that a large quantity of Idaho ore was in storage at various reduction works at the end of the year. One smelter, for example, treated during the year only a little over 3 per cent of its Idaho receipts. Much of the production came from the Snowstorm mine, in the Coeur d'Alene district, and from the White Knob mine, at Mackay, Custer County.

Smelters produced from ore of the Coeur d'Alene district about 6,600,000 pounds of copper in 1907. A part of this was from concentrates of the lead mills, but the greater part came from the Snowstorm mine. The Snowstorm deposit[e] consists of a zone in pre-Cambrian quartzite that contains disseminated particles of chalcopyrite, bornite, and chalcocite, which in places are oxidized. A fault is supposed to cut off, not far below the deepest workings, the beds in which ore has thus far been developed. The ore averages about 3.6 per cent copper, 6 ounces of silver, and 0.05 ounce of gold. It carries very high silica, in consequence of which it is given a favorable reduction charge by many smelting companies for use as converter lining. Such of the oxidized ore as is of too low grade or contains too little silica to be shipped for this purpose is treated by leaching at the mine and yields about 2.2 per cent copper and a little silver.

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[a] Spencer, A. C., Bull. U. S. Geol. Survey No. 213, 1903, pp. 158–162.

[b] Emmons, W. H., Bull. U. S. Geol. Survey No. 285, 1906, pp. 125–128.

[c] Lindgren, W., Bull. U. S. Geol. Survey No. 340, 1908, pp. 158–167.

[d] Emmons, S. F., Bull. U. S. Geol. Survey No. 260, 1905, pp. 221–232.

[e] Ransome, F. L., Bull. U. S. Geol. Survey No. 260, 1905, p. 301; also Prof. Paper U. S. Geol. Survey No. 62, 1908, pp. 150–152.

At Mackay the White Knob mine and smelter were operated for a time under lease, and later by the Empire Copper Company. Operations were suspended in the fall of 1907. The ore bodies have the characteristics of contact-metamorphic deposits, but lie in porphyry, near limestone. The ore is oxidized down to a depth of 600 feet, and is of moderate grade in copper, gold, and silver. Sulphide ore from Bingham was brought in and smelted with the oxidized ore. The matte produced was returned to the Salt Lake Valley for conversion. The Lost Packer smelter at Ivers, Custer County, turned out some matte from its chalcopyrite lode in granite. The matte was shipped east for conversion. The Panhandle Smelting Company (Limited), at Ponderay, produced a little copper matte in its lead furnaces.

The Seven Devils district, in Washington County; the Copper Queen mine, in Lemhi County; and the Weimer Company, in Fremont County, were among the other producers of the State.

A small amount of copper was recovered as matte in lead furnaces outside the State and was turned into blister in the East. In 1907 Idaho copper was turned out at a number of smelters located in British Columbia, Washington, Oregon, California, Montana, Idaho, Utah, Colorado, and Pennsylvania.

MICHIGAN.

General statement.—The smelter production of copper in Michigan in 1907 was 219,131,503 pounds, as compared with 229,695,730 pounds in 1906. Had it not been for the unfavorable conditions of the latter part of the year, the production would probably have shown a small gain over that of 1906. The difference between the smelter production and the mine production, as shown on page 18 is due to the fact that a few companies sent to the smelters in 1907 not only the year's production of the mines, but also some material that had been mined and milled previously. The same condition of affairs existed in 1905 and 1906. The entire production of the State comes from the single district on Keweenaw Peninsula, embracing parts of Houghton, Keweenaw, and Ontonagon counties.

Lake Superior region.—The Lake Superior copper region of the Upper Peninsula of Michigan is, as is well known, the great native-copper district of the world, although native copper in similar occurrence is found in Bolivia and, in less important deposits, in Alaska, Pennsylvania, and Virginia. The metallic copper occurs as masses of various size, from minute particles up to huge masses hundreds of tons in weight, contained in certain beds of a thick series of basic lavas and in some of the intercalated sandstone and conglomerate beds, all of pre-Cambrian age. These cupriferous layers, or lodes, carry a little native silver with the copper. Though at present of low grade, they are for the most part characterized by remarkable uniformity of copper content and by great extent. The richest and the poorest ores differ in yield by less than 2 per cent copper. The Kearsarge lode, for example, is being actively mined for a distance of about 12 miles almost without break, and several other lodes are worked for more than 2 miles along their strike, while mining has been carried down the dip of the various lodes from a few hundred feet to more than a mile and a half. At the maximum vertical depth attained—practically 1 mile, and deeper than anywhere else in the world—the general character of the ores remains unchanged, though their richness has decreased somewhat.

The general similarity of geologic conditions, the uniform value of the ores, and the extent and regularity of the lodes necessarily cause any account of a year's progress in the Lake Superior copper district to be little more than a chronicle of mechanical achievement. Number of feet of new development, increase in hoisting capacity, enlargement and improvement of mills and smelters—these more than any change in the ore deposits themselves generally measure the advances for the year. The result of this permanency and regularity of the lodes is seen in the wonderful equipments, the immense capacities, and the permanent character of all important undertakings. This district mines and mills a larger tonnage of ore than any other district in the world, and more than is mined in any State with the possible exception of Missouri.

The mines are worked to great depths, mostly through inclined shafts, but a few vertical shafts reach the deepest workings. Pillars are left to suport the hanging wall, even in many places where the grade of ore is good, but are planned to be ultimately extracted. Underground sorting of the ore, leaving the worthless rock as filling and keeping drifts and chutes open by dry walling, is a system coming into use, especially in the wider lodes. Much heavy timber is required, however, in some of the mines, especially those working conglomerate ores. Although the sumps of most of the mines are far below the level of Lake Superior, water gives little trouble in most cases and is kept at the desired level by comparatively light pumping.

Lake Superior affords the tremendous volume of water required by the mills. In addition to local transportation by the Mineral Range and the Copper Range railroads and numerous private lines between mines, mills, and smelters, the region is joined with the main lines of traffic by the Chicago, Milwaukee and St. Paul, and the Duluth, South Shore and Atlantic railroads. Most important of all the deep-water transportation of the Great Lakes is brought through the heart of the district by Portage Lake and the Houghton Ship Canal. Pennsylvania coal is therefore cheap, and the outgoing copper has to stand only a trifling freight rate as far as Buffalo. Electric power generated at central plants seems destined to replace steam for most purposes at the larger mines. Pumping and underground haulage are done to an increasing extent by electricity. European labor is employed very largely, and the wages are low as compared with those paid in western camps.

With the exception of the comparatively small amount of coarse copper—" mass " and " barrel work "—sorted out at the mines, all the ores are subjected to crushing by steam stamps, followed by concentration. As the result of experiments with various types of crushing and concentrating machinery, the newest milling equipment consists of Nordberg steeple-compound stamps, Woodbury-Benedict jigs, some kind of regrinding mill, and either Wilfley or Deister tables, thus indorsing the established practice at the Lake. Increased recovery by finer grinding is especially being sought, and a large plant for treating what heretofore have been tailings is being erected by the Calumet and Hecla Company. The " mineral " or concentrates from the mills is treated by a combined melting and refining process which is very cheap as compared with the transformation of sulphide ores into electrolytic copper. A small proportion of the total output is sufficiently argentiferous to make electrolytic refining profitable. Owing to the increasing quantity of distinctly arsenical copper produced and to the growing demand for metal of high conductivity, removal of the arsenic by electrolysis is done to an increasing extent, about 16 per cent of the total having been electrolytically refined in 1907, as compared with about 10 per cent in 1906. Preparations for increasing the present output are now underway, and the proportion of electrolytic copper from Michigan seems certain to increase materially. The total silver produced averaged on the total tonnage mined was 0.03 ounce per ton. A very small part of this was recovered at the stamp mills as " pickings." The silver recovered by electrolysis amounted to about 0.008 ounce per pound of copper electrolyzed, or 0.55 of a cent. During 1907 the Michigan, Quincy, and Dollar Bay smelters and the two smelters of the Calumet and Hecla Company, one at Hubbel and the other at Black Rock, N. Y., treated about 344,000,000 pounds of concentrates, the product of about 9,970,000 tons of ore. Of this, 9,892,214 tons were mined and milled in 1907.

The smelter production of the Lake district for 1906 and 1907 is shown in the following table. The figures of production of individual companies have already appeared either in their annual reports or elsewhere:

Smelter production of copper in Michigan in 1906 and 1907, by companies, in pounds.

Company.	1906.	1907.	Company.	1906.	1907.
Adventure	1,552,628	1,244,874	Tamarack	9,832,644	11,078,604
Allouez	3,486,900	2,934,116	Trimountain	9,507,933	8,190,711
Atlantic	1,439,082	....	Victoria	546,334	1,207,337
Baltic	14,397,557	16,704,868	Winona	278,182	1,285,863
Centennial	2,253,015	2,373,572	Wolverine	9,548,123	9,272,351
Champion	16,954,986	16,489,436	Ahmeek, Arnold,[a] Calumet and Hecla, Copper Concentrating,[b] Lake,[a] Rhode Island,[b] and Tecumseh [b]	103,272,057	92,498,759
Franklin	4,571,570	4,401,248			
Isle Royale	2,937,098	2,667,608			
Mass	2,106,739	2,078,677			
Michigan	2,875,341	2,665,404			
Mohawk	9,352,252	10,107,266			
Osceola	18,588,451	14,134,753	Total	[c]229,695,730	[c]219,131,503
Quincy	16,194,838	19,796,058			

[a] Did not produce in 1906.

[b] Did not produce in 1907.

[c] As already stated on page 14, the basis on which these figures are compiled is as nearly as possible the same as that employed in arriving at the production of blister copper in other districts. To the output of furnace-refined Lake copper, locally called " ingot " copper, is added the quantity of anodes made by smelting Lake Superior concentrates for electrolytic refining. These figures, therefore, include only in part the refined copper product of Michigan. Further reference to this subject is made under the heading " Lake copper " on pages 59–62.

For the marked falling off in production two causes may be ascribed. In 1906 the smelters turned out, in addition to the mine output for the year, 5,123,420 pounds of copper from concentrates produced in previous years, whereas in 1907 the smelter output was only 1,364,271 pounds greater than that of the mines for that year. For some time prior to 1905, with copper selling at a low figure, some "mineral," the stamp-mill concentrates, had been stored for better prices. Under the favorable market of 1905 a large part of this accumulated mineral was smelted and sold. In 1906 the higher price for the metal brought out an additional portion, though smaller than in 1905, and in the early part of 1907 probably most of the remainder was disposed of. Under the low prices for the latter half of the year accumulation was reverted to. According to its annual report for the year ending April 30, 1908, the Calumet and Hecla Company, which has been the chief follower of this policy, stored without smelting mineral produced during the year equivalent to over 7,500,000 pounds refined copper. This company has unusual facilities for profiting by changes in the market in this way, for, owing to the fact that part of its mineral is smelted at Buffalo, large storage capacity for mineral is required by the intermittence of Lake transportation. Three other companies in 1907 smelted somewhat more mineral than they produced within the year.

The second reason for decreased production is that 11 of the 21 mining companies that produced in 1907 made smaller outputs than in 1906, and 4 small contributors to the total of 1906 did not produce in 1907. The decrease thus caused considerably overbalanced the combined gain made by 8 companies and the small addition by 2 new producers in 1907. The consequent reduction in mine production for the year was 6,805,078 pounds. As distinguished from 1906, when the mine production was seriously affected by labor troubles and numerous accidents, there is little of such things to chronicle for 1907. It is true that severe weather early in the year hampered transportation somewhat and thus affected production, and that the effect of two acidents that occurred in 1906—the caving at the Atlantic mine, and to some extent the fire at the Tamarack—continued in 1907, and thus caused the district's output to be less than it would otherwise have been. On the whole, however, the year was very favorable to the copper industry from a physical standpoint, and other causes must be looked to for an explanation of the lowered output.

The most patent of these causes is that certain companies reduced their tonnage from the preceding year or restricted the normal daily rock output. Of these companies, the Wolverine was prevented by heavy snows from delivering its usual tonnage to the mill early in the year. The Trimountain Company devoted especial energy to development throughout the year, with a consequent lowering of tonnage. The Osceola, Isle Royale, and Tamarack,[a] mines of the so-called Bigelow group, made important curtailment of output during the last three months of the year, in common with many other mines of the United Metals Selling-Amalgamated affiliation.

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[a] The Tamarack tonnage, however, owing to improvement of conditions resulting from the fire, was larger than in 1906; and it should be added that the Ahmeek, a newly developing Bigelow mine, maintained steady production.

Except in the case of the Osceola, however, these reductions of tonnage did not materially change the copper output from that of 1906. On the other hand, all the other companies that produced throughout both years, except the four mentioned, mined and milled more ore in 1907 than in 1906, so that the total ore stamped, 9,892,214 tons, was an increase of 988,087 tons over the corresponding tonnage for 1906.

By far the most effective cause of the decrease in production is the fact that in the case of all but two mines, the Mohawk and the Wolverine, the average yield per ton of ore stamped was less than in 1906, and the average for the whole district fell from 25.2 pounds per ton, or 1.26 per cent, in 1906, to 22 pounds, or 1.1 per cent, in 1907. This very marked decline in grade can not be ascribed in more than slight degree to any deliberate policy of mining the lower grade ores during the year, for in 1906 there was a greater incentive to the pursuit of such a policy, inasmuch as good prices were in effect during the whole of the year, as compared with only a part of the year 1907, and the average receipts per pound in 1906 were undoubtedly higher than in 1907. It is hardly to be questioned, therefore, that the actual grade of the lodes decreased fully 3 pounds per ton from the yield of 1906, and although it has long been known that the Lake ores are gradually becoming leaner, it is doubtful if so large a decrease has ever been experienced in any year of good prices since important operations have been carried on over a large part of the district.

How general the increase in tonnage and the decrease in grade were in 1907 may be seen from the accompanying table, in which the tonnage and yield for 1906 and 1907 are given for each company that produced regularly during both years. Concerning the 4 mines at the bottom of the list, which are grouped to avoid disclosing figures they have not made public, it may be stated that in the case of each the tonnage milled was larger and the yield per ton lower in 1907 than in 1906.

Tonnage and yield of ore milled by principal Michigan companies in 1906 and 1907.

Company.	1906.		1907.	
	Tonnage.	Yield per ton.	Tonnage.	Yield per ton.
	Short tons.	*Pounds.*	*Short tons.*	*Pounds.*
Alllouez	178,400	19.54	214,720	13.66
Baltic	649,932	22.15	761,288	21.94
Centennial	166,000	13.58	200,040	11.86
Champion	671,785	25.2	708,685	23.27
Franklin	372,378	12.27	383,290	11.48
Isle Royale	192,210	15.3	175,450	15.2
Mass	185,789	11.3	204,599	10.16
Michigan	140,225	20.4	150,407	17.72
Mohawk	618,534	15.12	640,777	15.77
Osceola	1,016,240	18.3	811,603	17.4
Tamarack	389,680	25.2	532,400	20.8
Trimountain	506,924	18.76	444,358	18.43
Wolverine	352,890	27.06	340,613	27.22
Adventure, Ahmeek, Calumet and Hecla, and Quincy	3,344,641	32.6	4,125,618	27.0

Only 5 mines in 1907 worked ore yielding 1 per cent copper or more. With the exception of the Allouez mine on the Kearsarge lode, the most important decrease in grade was felt by the 2 mines on the Calumet conglomerate lode, the Calumet and Hecla and the Tamarack. The importance of the decline in yield of this lode will be appreciated when it is recalled that, with an average yield of 36.7 pounds per ton in 1907, it is by more than 15 pounds per ton the richest lode in the district, and that it produced nearly 40 per cent of the total mine output of the district in 1907. According to testimony given in 1907 by the president and the general manager of the Calumet and Hecla Company, they estimate that the conglomerate lode will be exhausted in their ground in ten to fifteen years. The tonnage remaining at present is estimated at about 20,000,000 to 25,000,000 tons. Since by far the greater part of the lode is now opened up in their property, this estimate should prove to be not far wrong. But it is not reasonable to suppose that the grade of the ore, which heretofore has steadily fallen off, will continue to decrease from the present value of about 40 pounds per ton (in Calumet and Hecla ground), since a large part of the production before the lode shall be exhausted will come from good ground of the "Five Forties" tract and from pillars left in ground mined previously that was richer than the present average. On the other hand, if the company is to continue increasing its tonnage from its amygdaloid lodes, the Osceola and the Kearsarge, it is probable that the yearly output from the conglomerate will decline, so that the richness of this lode will have less influence in upholding the average yield for the district.

The Tamarack Company, working the "deep" of the Calumet conglomerate and hoisting its tonnage from an average vertical depth of over three-fourths mile, produced copper at such a cost, even before the recent fire, that operation will be profitable only at a better price average for the metal in the next few years than has obtained for the past twenty-five years. If the decline in richness at the Tamarack continues with increasing depth, it is not unlikely that the greatest lode of the Lake country, the Calumet conglomerate, will have ceased to add to the output of the district by the time it is exhausted in the Calumet and Hecla ground. In this connection it is interesting to note that the Franklin Company, the only other producer of conglomerate ore, has decided to bring operations to a close on the Albany and Boston or Allouez conglomerate. Unless, therefore, a favorable outcome shall mark the prospecting on the Allouez conglomerate now being carried on in Keweenaw County with as yet wholly uncertain results, the whole output of the Lake district seems certain to be drawn entirely from the amygdaloid lodes.

With the Baltic lode yielding a little over 1 per cent, and the Kearsarge, Pewabic, and Osceola lodes each yielding distinctly less than 1 per cent, and with no indications from present developments of any factors to increase materially the average yield for the region, it seems plain that the average Lake Superior ore will soon be yielding under 1 per cent copper. How much effect in delaying this condition will be made by the reduction of output from the lowest grade ores consequent on the present low price of the metal, it is impossible to state.

If, however, on exhaustion of the Calumet conglomerate, the present total metal output can be maintained by increase from the principal amygdaloid lodes or from other amygdaloids of equal richness, the consequent lowering in average yield will not be an unmixed evil because of the much lower cost of treatment of amygdaloid ore than of conglomerate. In fact, if the average amygdaloid yield should range between 17 and 20 pounds per ton, the dividend column should not especially suffer under a reasonable copper market; and with the recent important developments on the Kearsarge, the Baltic, and the Osceola lodes, the district should produce sufficiently to be the largest copper district in the country, thus regaining the rank it held for so long a time before being displaced by Butte.

Several events of great moment to the district and of importance to the copper industry generally took place during the year 1907. These concerned the administration or control of several important properties, but in their broadest aspect are of most significance to the industry generally as affecting the selling of a large part of the Michigan copper output. They were: 1. The unsuccessful attempt early in 1907 to effect a consolidation of the three Copper Range companies with several other Lake companies. 2. The passage under Calumet and Hecla management, by virtue of stock ownership, of the Allouez and Centennial companies at the beginning of 1907. 3. The suits to prevent similar assumption of the management of the Osceola Company by the Calumet and Hecla Company. The outcome of this litigation, which began early in 1907 and continued into 1908, can not fail to have a very important effect on the Michigan copper industry, and the decision, which is expected at an early date, is being awaited with much interest.[a]

MONTANA.

In 1907 Montana produced 224,263,789 pounds of blister copper, and by reason of the great decrease from 294,701,252 pounds in 1906 took second rank among the copper-producing States for the first time since 1891. The reduced output resulted mainly from curtailment or suspension of production by several important producers. Severe weather early in the year caused a small decrease. The output from the mines was a little lower than that of the smelters, mainly because the latter continued in full operation a little longer than the mines.

Butte district.—Nearly the entire production of the State came, as in former years, from the Butte district, in Silver Bow County, which still retains its rank as the greatest copper camp in the world. The mines of the Amalagamated, the North Butte, the Butte Coalition, the Clark, and the Pittsburg and Montana companies were the chief producers, but the East Butte, the Bullwhacker, and a few other companies contributed to the production. With the falling price of copper the Amalgamated Company decided to produce less copper, and restriction began about the middle of September. Work on the lower-grade ores, which yielded copper only at a high cost, was suspended, and energy was concentrated on the richer ores found mainly in the Boston and Montana mines. In November the Amalgamated smelters stopped the receipt of custom ores, and in the middle of December the Washoe plant closed entirely. The Boston and Montana smelter and refinery at Great Falls continued in operation, but its output was considerably smaller than in 1906.

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[a] Since the foregoing was written it has been announced that the judge of the United States circuit court has rendered a decision in favor of the Calumet and Hecla Company.

The veins are contained in a granite rock, greatly shattered, and much altered in the vicinity of the ores.[a] The original mineralization resulted in the formation of cupriferous pyrite, especially along fractures and fault zones. Concentration by descending waters has gone on to a remarkable extent and makes the Butte deposits the best-known example of secondary sulphide enrichment. Rich secondary ore has now been encountered at a depth of 2,600 feet, and is the deepest secondary copper ore known. These occurrences, however, do not guarantee the general presence in the camp of similar ore bodies at that depth. Where oxidizing waters have not been able to penetrate freely, the pyritic ore is encountered little enriched from its original state, as, for example, at the 1,600-foot level of the Anaconda lode, and at about the same elevation in a number of other places; and these deep ore bodies of good grade are probably to be regarded as localizations of secondary enrichment along certain easily permeable channels, after the order of those found at depth in the Globe district of Arizona. The principal copper mineral is chalcocite, and about 90 per cent of the output in 1907 came from this mineral. Enargite contributed the bulk of the remainder, although secondary bornite and chalcopyrite furnished a little, and a comparatively small quantity came from oxidized ores from the eastern part of the camp.

Owing to the great quantity of low-grade concentrating ores, comprising almost 85 per cent of the total ore treated during the year, the average copper yield is low, approximately 2.75 per cent in 1907; and, notwithstanding the abandonment of lower-grade ores during part of the year, the copper recovered declined from 1906, when the average yield was 3.15 per cent. The high loss attending a close separation of ore and gangue and the considerable percentage of chalcocite-coated pyrite in the ore permit only a low concentration, the average being close to 3 into 1, which is a higher ratio than obtained in 1906. Concentrating ores, yielding about 2.3 per cent copper, supplied over 70 per cent of the total output, the remainder coming from smelting ores, which averaged about 5.2 per cent yield. The yield in silver is rather high, the average in 1907 being about 2.3 ounces per ton of ore. Gold is comparatively lower, the yield per ton of ore being 0.014 ounces. The precious metals therefore reduced the cost of copper production by about 2.2 cents per pound in 1907. The recovery of arsenic from the enargite ores, as practiced at the Washoe smelter, is also a source of revenue.

The productive area is remarkably small for so great an output. The great activity recently manifested in exploration for an extension of the profitable ground to the north, south, and east has been attended with little success, except in a very few cases. The most important developments continue to be in depth; the fine showing in the bottom of the North Butte and the continuance of good ore on the 2,600-foot level of the Anaconda mines are the most noteworthy features of the year. The aggregate tonnage of ore remaining in the mines is known to be large, but figures have not been given out.

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[a] A geological study of the Butte district has been made by W. H. Weed, and the report, to be published by the Geological Survey, is expected to appear shortly.

Most of the Butte ore bodies are large, although more tabular than in many copper camps, and hence not always especially wide. Square-set mining is the prevailing system; the cost of timber to the Amalgamated mines is reduced through control by that company of extensive timber lands. Little trouble is experienced from excessive water. Three trunk lines bring supplies into the district and afford communication with the smelters at Helena and Great Falls. A private standard-gage line connects the mines with the Washoe plant at Anaconda, where nearly three-fourths of the ore is treated. Coal for coke and power comes largely from the mines of the Amalgamated Company in Montana and Wyoming, but the use of electric power derived from hydraulic installations is increasing for nearly all purposes, including pumping and underground haulage. American labor is extensively employed and receives high wages. When the price of copper fell below 18 cents the miners returned to the lower wage scale of previous years, according to their contract.

The Butte Reduction Works, which concentrate and smelt the Clark ores, was operated steadily, and the Pittsmont smelter ran for a part of the year. The Great Falls plant, which is the fourth largest copper smelter in the country, being exceeded only by the Washoe, the Copper Queen, and the Michigan works, handles the output of the Boston and Montana mines, both smelting and concentrating ores, as well as some of the rich ores from other companies. The great Washoe plant at Anaconda, which has the largest copper smelter and one of the largest concentrating mills in the country, treated all the rest of the Butte output with the exception of a small quantity, which went mainly to lead smelters. These various smelters handled in 1906 about 1,710,000 tons of ore and concentrates from the Butte district, representing about 3,900,000 tons of crude ore. Of this about 606,000 tons were smelted without concentration. There was also treated a small amount of custom ore from other Montana districts and considerable siliceous copper ore for converter lining from the Coeur d'Alene district in Idaho.

NEVADA.

The output of blister copper from Nevada in 1907 was 1,998,164 pounds, as compared with 1,090,635 pounds in 1906. The principal production came from a number of mines in Lander County, but the Mason district in Lyon County and Pioche in Lincoln County, and several other counties contributed from 100,000 to 300,000 pounds each. Most of the ores were shipped to smelters. The production from Pioche came chiefly from copper-lead ores. In the Golconda district the comparatively low-grade copper ores were extracted by the novel McQuisten-tube concentration process. Production from the deposits at Yerrington showed a marked decrease. Oxidized ore from that camp was shipped to Salt Lake smelters, but sulphide ore has been encountered at several points. The deepest workings have a depth of about 650 feet. The primary ores are of contact metamorphic origin, consisting of pyrite and chalcopyrite in a gangue of garnet, epidote, and pyroxene. According to F. L.

Ransome[a] of the U. S. Geological Survey, the ore bodies lie in the altered limestone at some little distance from the contact with the intrusive rock; the ores are mostly of low grade, but the developments to date are encouraging as to their extent.

Only slight production was made from the Ely district in White Pine County. The ores of this camp are of the well-known type-disseminated enriched sulphides in porphyry and some of the adjacent rocks. An enormous tonnage has been developed, and plants have been erected for its treatment. The Ruth and Eureka or Copper Flat mines of the Nevada Consolidated Company have developed, according to latest estimates, fully 20,000,000 tons of ore averaging slightly under 2 per cent copper, with a minimum of 1.25 per cent. If it is found that ore carrying down to 1 per cent can be profitably worked, the tonnage will be much larger. This ore is expected to average about 40 cents per ton in gold and silver, running 0.01 to 0.02 ounces in gold and 0.3 to 1 ounce silver. At the Veteran mine of the Cumberland Ely Company a large body has been developed, said to contain about 4,000,000 tons averaging about 3.4 per cent copper. The report of the Giroux Consolidated Company states that 4,000,000 tons of concentrating ore, carrying at least 2.25 per cent copper and 20 cents gold per ton, have been developed, in addition to 350,000 tons of 6.5 per cent smelting ores. There is reason to believe that the reserves in all these mines will be materially extended.

In most cases mining will be done at a depth not exceeding 500 to 600 feet, but one of the Giroux ore bodies lies at a depth of over 1,000 feet; despite that fact, the ore is oxidized. The Copper Flat ore body is being stripped and extracted by steam shovels. The other mines will be worked by a sublevel caving method. The Giroux Company finished its blast furnace and 500-ton mill in 1907, but through failure of water supply and for other reasons did not begin regular operation. Work on the great Steptoe plant was practically suspended for a time during the financial depression but was resumed early in 1908, and both milling and smelting have been begun. The plant is to consist for the present of three 1,300-ton concentrating sections, which concentrate on an average of about 7 into 1, McDougal roasters, 3 large reverberatories, one 20-foot blast furnace, and 3 converter stands. The present capacity is designed for 4,000 tons of ore, and the plans permit an expansion to 13,000 tons daily. An extraction of at least 70 per cent is expected in the mills, and it is estimated that copper can be put on the market at a cost of about 8 cents per pound. Extensive experiments are to be made on sintering of concentrates in the hope of finally avoiding the use of reverberatories.

NEW MEXICO.

The production of blister copper in New Mexico in 1907 was 10,140,140 pounds, a marked increase over the production of 1906, which was 7,099,842 pounds. This production came principally from the Santa Rita-Hanover and the Burro Mountain district in Grant

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[a] An account of these deposits by Mr. Ransome will soon be published by the U. S. Geological Survey.

County, but notable production came from the San Pedro camp in Santa Fe County, from the Organ Mountains in Dona Ana County, and from the Jarilla and Tularosa districts of Otero County.[a]

Santa Rita-Hanover district.—The deposits of the old Santa Rita district, east of Silver City, made an output of about 5,000,000 pounds in 1907, mainly through the operations of leases from the Santa Rita Mining Company. The surface quartzite, which ranges up to 200 feet in thickness and is underlain by porphyry, carries cuprite and native copper in its countless fractures and joints. The known bodies of rich chalcocite ore in the porphyry have now been almost exhausted, and the bulk of production in 1907 came from the quartzite ores. The deepest workings are slightly over 400 feet and are reached by shafts, while shallow pits with windlasses or whims serve the Mexicans in their leasing operations. The ore bodies in quartzite are commonly small and require little or no timbering. The native copper and cuprite are recovered mainly by cobbing and by the use of hand jigs, though a mill is operated part of the time. The rich concentrates are shipped to El Paso for smelting.

In the Hanover section of the district, lying just east of Santa Rita, the ores occur chiefly as contact-metamorphic deposits in limestone. At the Hanover mine, another old working, the ores have been greatly oxidized and secondarily enriched. The Hermosa Copper Company produced heavy pyrite-chalcopyrite ores from limestone replacement bodies. The ores of this camp go to Silver City and to Arizona smelters for treatment. Branch lines of the Santa Fe Railroad enter both this and the Santa Rita camp.

Burro Mountain district.—The Burro Mountain district, southwest of Silver City, produced in 1907 about 2,100,000 pounds, a somewhat decreased output from that of 1906. The principal producer was the Burro Mountain Copper Company, which operated a concentrating mill at its mine at Leopold. Other properties, however, produced to some extent. The most important ores are stockworks, carrying chalcocite-coated pyrite in crushed and altered porphyry. The ore of workable grade has been produced by enrichment from above. The greater part of these ores is of concentrating grade. Some richer oxide ores carrying carbonates and chrysocolla occur in the district and were mined to a small extent in 1907.

The mines are less than 400 feet deep, and are not very wet. Square setting is employed in the stopes. Mexican labor is employed largely. The concentrates are shipped to Arizona smelters, and some ore goes to the Comanche smelter at Silver City, whence matte is shipped to Arizona for conversion. This plant closed in December, 1907.

Other districts.—The smelter of the Santa Fe Gold and Copper Company at San Pedro, Santa Fe County, was blown in early in the year 1907, after several years' idleness, and operated till October, when the price of copper made it necessary to stop production. The ore is of contact-metamorphic origin, consisting essentially of garnet, magnetite, and chalcopyrite replacing a bed of limestone near porphyry. The ore yielded about 2.9 per cent copper and $1.25 per ton in gold and silver. The matte was shipped east for further treatment.

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[a] For brief description of the ores of these districts, see Lindgren, W., and Graton, L. C.; Bull. U. S. Geol. Survey No. 285, 1906, pp. 74–86. A more detailed report is in preparation.

At Oro Grande, in Otero County, the Southwest Smelting and Refining Company blew in its new 250-ton blast furnace late in the year, making matte, which was shipped east. The ore was drawn chiefly from contact-metamorphic deposits in the Jarilla district.

Attempts at leaching the disseminated ores in sedimentary rocks were again made at several places in the Territory, but the fall in the price of copper put an end to these operations. The smelter of the National Mining and Smelting Company at Deming turned out some copper matte from its lead furnace.

TENNESSEE.

In 1907 Tennessee produced 19,475,119 pounds of blister copper, as compared with 17,809,442 pounds produced in 1906. This output came exclusively from the Ducktown district.

Ducktown district.—The Ducktown district, in Polk County, in the southeastern part of the State, was in 1907 the ninth copper camp in the United States in point of production and the principal copper-producing region in the Eastern United States. The entire output of Tennessee came from the Tennessee Copper Company and the Ducktown Sulphur, Copper and Iron Company. The output can be materially increased when the conditions warrant.

The ores lie as great lenticular masses of sulphides parallel to the steeply inclined foliation of schists. Both the ores and the schists are probably of pre-Cambrian age. The ore minerals are predominant pyrrhotite with chalcopyrite and pyrite. Oxidation of the upper portion of these deposits produced heavy gossan, underlain by rich secondary chalcocite ores, long ago exhausted. The entire output now comes from the primary ores. The reserves of ore are large. The Tennessee Copper Company at the end of 1907 reported 2,293,369 tons of ore developed and 1,030,000 tons additional of probable ore.

The ores are low grade, the average recovery in 1907 having been about 35.4 pounds blister copper per ton, or 1.77 per cent, a slight increase over the yield in 1906. Precious-metal values are also low, and part of the copper is sold as pig copper without refining. The blister which in 1907 was refined in this country by electrolysis amounted to a little less than half the total output for the year, and such part of it as was not mixed with the product of custom ores yielded precious metals to the value of 0.44 cent per pound, 0.04 cent of this being gold. The unrefined blister is exported to Europe.

The ore bodies as yet developed lie within a few hundred feet of the surface, the deepest shaft being a little over 700 feet. The steeply inclined attitude of the deposits and the great strength of the schist walls permit great stopes to be opened and ores extracted by a system of underground quarrying without the use of timber. The present crude method of loading the ore into cars at the foot of the quarry face is to be replaced in the Tennessee Company's property by the use of a mechanical dipper shovel, following the example set by Joplin, Mo. Twenty-foot slices are left under each level to keep the lode open, but these are to be extracted ultimately. Light pumping controls the water. Coal and coke come from Tennessee and West Virginia, and are cheap as compared with Western prices. A branch line of the Louisville and Nashville Railroad serves the district, and the mines and smelters are connected by private lines. Native white labor is employed largely, but some Europeans also are employed; the wages are low.

Pyrite smelting is now practiced with much success at the smelters of both companies, and the first matte is further concentrated before conversion, but decided improvements recently achieved indicate that the second smelting may ultimately be dispensed with. Siliceous ore has been sought throughout the South, but has been secured with difficulty, and barren quartz is largely used. The matte of the Ducktown Company was converted at the Tennessee plant during the first part of the year, and later at refineries on the coast. At the two smelters a little over 558,000 tons of Ducktown ore were treated, in addition to a small quantity of siliceous copper ore from North Carolina.

The great sulphuric acid plant of the Tennessee Copper Company was finished and began operation near the end of 1907, and the sulphurous oxide is now removed from the blast-furnace gases. As a result, the suit brought against the company by the State of Georgia for alleged damage to agriculture and forests is likely to be dismissed. Furthermore, the great demand for fertilizer in the South creates a market for sulphuric acid that will make its manufacture a source of profit to the company.

UTAH.

In 1907 Utah produced 66,418,370 pounds of blister copper. The increase from the production of 1906, which was 50,329, 119 pounds, was much the largest gain of any State during 1907. Part of this production was from ore mined and shipped to the smelters in 1906, and on this account the mine production, which exceeded that of the smelters in 1906, fell below the smelter output in 1907.

The production was derived chiefly from three important districts, Bingham, Tintic, and Frisco.

Bingham district.—The Bingham or West Mountain district, in Salt Lake County, is now fifth in the country in point of copper production, having to its credit a smelter output for 1907 of about 47,000,000 pounds. Production was restricted in the early months by lack of fuel, was hampered throughout the year by inadequate transportation, and finally suffered at the end because of the low copper market. Two main types of copper deposits[a] occur in the camp. The deposits which up to the present have been most productive are large replacement bodies of heavy pyritic ore in limestone near the contact of a porphyry. Chalcopyrite is present in the pyrite, and gives the ore its value in copper. The ores are mostly massive and comparatively impervious, and oxidation with accompanying secondary enrichment has proceeded to relatively shallow depths. At present practically all the copper from the deposits of this type is derived from the primary pyritic ore. The second type of ore deposit has only recently been actively exploited, but its contribution to the district's output in 1907 was considerable, and is certain, at an early date, greatly to increase the output of the camp. These ores are mainly disseminations in silicified porphyry of pyrite and chalcopyrite, either coated or completely replaced by secondary chalcocite. The immense deposit being worked jointly by the Utah Copper and the Boston Consolidated companies is a disseminated deposit, which appears independent of important fissures and fractures. In the Ohio Copper Company's property the secondary ore is more confined to definite fractures and veinlets, and where these are in quartzite the copper occurs chiefly as cuprite and native, as at Globe, Ariz., and at Santa Rita, N. Mex. By tunnels and diamond drilling, these great deposits have been proven to extend several hundred feet below the surface. Of important is the practical absence of gossan and the unusual shallowness of the oxidized zone, as represented by the practically barren cap rock.

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[a] See Boutwell, J. M., Prof. Paper U. S. Geol. Survey No. 38, 1905.

In copper content the ores of the pyritic replacements of limestone vary greatly. Many of these bodies are in places too low grade to be worked in entirety, and the average grade of ore mined in a year is therefore affected by the price of copper at that time. In the case of companies that do considerable custom smelting, like the Bingham Consolidated and the United States companies, heavy pyritic ore that would not be profitable for its copper content alone can be used to advantage because of its excess in iron. The average recovery of copper in 1907 from all these replacement ores, of which about 605,000 tons were treated, was undoubtedly lower than for previous years, and was about 2.3 per cent, though the range of copper was from less than 1 per cent to over 3 per cent, and of precious metals from 65 cents to $3.10 per ton. The gold and silver values, which are considerable, help materially, and the lead ores encountered in some abundance in certain of the mines also aid in reducing the cost of copper production. The great disseminated chalcocite deposits have been estimated by very extensive sampling to contain an average of between 1.5 and 2 per cent copper. The yield from concentrates smelted in 1907, representing over 700,000 tons of ore, was about 1.2 per cent copper, 17 cents gold, and 5 cents silver per ton, or nearly 1 cent in precious metals per pound of copper.

Reserves well in advance of production were maintained by the important copper producers. The estimated reserves of sulphide ore in the Utah Consolidated Company's Highland Boy mine were increased during the year from 1,100,000 to 1,202,930 tons. The latest estimate of tonnage in the porphyry mine of the Boston Consolidated Company, gives 58,580,910 tons developed, with an average copper assay of 1.5604 per cent. Gold and silver recovered at the mill amount to about 12 cents per ton. In the Utah Copper Company's portion of the same ore body there is estimated to be 60,000,000 tons of ore averaging about 2 per cent copper, and 0.15 ounce silver and 0.015 ounce gold per ton. Of this tonnage, one-third is fully developed, one-third partly developed, and one-third is estimated on the basis of a limited amount of development. There are also about 12,000,000 tons in this body averaging about 1.5 per cent, and an additional zone of this tenor, little developed but estimated to contain about 40,000,000 tons. A large tonnage is reported as developed in the Ohio Copper Company's ground.

The limestone replacement ore bodies are commonly large, tabular, and moderately inclined. They are worked mainly by the square-set system, with or without filling, but the horizontal slicing system with complete square-setting and consequent shooting of the timbers and caving is employed in the United States mines in Bingham, as in Shasta County, Cal. In the Bingham Consolidated mines some of the stopes are worked by a method of mill-holing and caving. This caving system is also used for certain portions of the disseminated deposit of the Utah Copper Company, but is to be gradually replaced by steam shovels. Ten of these shovels are now at work, either stripping or extracting ore, from the deposits of the Utah Copper and Boston Consolidated companies. A great part of the timber used in the district comes from Oregon and is expensive. Most of the ore bodies as yet explored lie within a few hundred feet of the surface. The deepest ore known in the district is in the Yampa mine, where the Craig tunnel cuts the lode at an inclined depth of 1,800 feet. The prevalence of deep, steep-sided canyons allows tunnels to be particularly effective means of opening the mines. With increasing depth of development, however, some of the mines have been forced to sink winzes below the lowest tunnel practicable. Water is not troublesome at present depths. Coal comes mainly from the eastern part of the State and is reasonably cheap, but electric power is used to a considerable extent. A branch of the Rio Grande Western Railroad connects the district with the Salt Lake Valley, where most of the smelters are situated. The Copper Belt Railroad and several aerial trams furnish additional local transportation. A new line connecting the district with the mills and smelter at Garfield was operated in 1907, but the service was unsatisfactory, and the companies concerned may build a private line. European labor is extensively employed, and the average wage is lower than in many other western camps.

The heavy pyritic ores are smelted, commonly after roasting, although pyrite smelting is practiced to some extent. The disseminated chalcocite ore is concentrated about 23 into 1, producing a concentrate yielding almost 30 per cent. The great mills of the Utah Copper and the Boston Consolidated companies situated near the Garfield smelter were well along toward completion at the end of the year. The Utah mill was then operating two-thirds of its 6,000-ton plant, and the 3,000-ton mill of the Boston Consolidated began concentration in 1908. A 2,000-ton mill was begun by the Ohio Copper Company. At the Garfield smelter, which was built chiefly to smelt the concentrates of this district, roasters and reverberatories are mainly employed, but in addition a Huntington and Heberlein pot-roasting plant is in operation, sintering part of the concentrates for treatment in blast furnaces. The capacity of the Garfield plant is being much increased. The Yampa Company added converters to its smelter at Bingham. At the Murray works of the American Smelting and Refining Company considerable copper was recovered in matte from the lead furnaces.

The United States court of appeals rendered a decision sustaining that of the lower court which enjoined the smelting in the valley south of Salt Lake of ores or mixtures containing over 10 per cent sulphur or any arsenic. As a result, the Bingham Consolidated, the Utah Consolidated, and the United States smelters closed down about the end of 1907. The Murray plant had already made an agreement with the farmers which permitted it to operate. The Utah Consolidated Company had already purchased a site in Tooele County, 4 miles north of the mine, where it plans the erection of a 1,500-ton smelter. The United States Company has since been allowed to run its lead smelter by the application of a process for profitably converting the sulphur fumes in the smoke into sulphuric acid. It is possible that the same company's copper plant may later be allowed to resume. The new plant of the Utah Smelting Company near Ogden was operated for a part of the year, turning into matte ores received from several States.

Some Bingham ore was shipped to the White Knob smelter at Mackay, Idaho, where its sulphur contents were utilized in smelting the oxidized ores of that camp. The Salt Lake Valley smelters treated a large quantity of copper matte from California and siliceous gold and silver ore from Nevada, also ore or matte from Idaho, Colorado, Wyoming, and Montana, in addition to the bulk of the copper output from other districts in Utah, including Tintic and Frisco.

Tintic district.—The Tintic district at Eureka, Juab County, is the second copper camp in the State and the tenth in the country, the smelter recovery of copper from its ores having been about 7,800,000 pounds in 1907. The camp is essentially a precious-metal camp, with copper and lead as accompanying metals of importance, but in varying quantities. The copper production for 1907 was derived in large part from the Centennial Eureka mine, but several other companies added more or less copper to the output of the district. The principal ore deposits[a] occur along fissures that extend outward in limestone from an intrusive mass of monzonite. The ore bodies are very irregular, but many are large. The chief primary ore minerals besides pyrite are chalcopyrite, enargite, galena, and specularite, with various silver minerals, all in a gangue of quartz and barite. Except in one case work on the limestone fissures has been stopped at or above the water level. Oxidation has extended with unusual completeness as far as the depth of these developments, but secondary deposition seems to have played little part in the distribution of values. Practically the only ores which have withstood oxidation are lead ores, in which some galena remains, and masses of enargite. Pyritic material is met with only rarely. The Gemini Company, in 1907, however, began exploration below the water level, which at that place is about 1,700 feet from the surface. Rich ore was encountered; at the 1,800-foot level assays ran as high as 8,500 ounces silver, 12 per cent lead, and 8 per cent copper on ore carrying native silver, argentiferous galena, and tetrahedrite (?). It is as yet too early to determine with certainty whether these high values are ascribable in any important extent to secondary enrichment, but there seems good reason to expect that primary ore of profitable grade exists below the zone as yet generally developed. The outcome of this work at the Gemini is of utmost importance to the district, even though very large reserves of ore are blocked out in some of the mines. Copper and gold appear to be most prevalent either rather near the outcrop of the monzonite body or in depth, and recent development in one important copper-gold mine at some distance from the monzonite outcrop shows the presence of the intrusive rock in the lowest levels. The geologic significance of this apparent distribution of the metals need not be dwelt upon here. The average yield of all the Tintic copper ores is in the neighborhood of 2.5 per cent of copper, but about equal value in each of the precious metals brings the total grade of the ore to a good figure. Bunches of very rich gold ore are sometimes encountered.

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[a] See Tower and Smith, Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1899, pp. 601–767.

Development is by means of shafts, the deepest of which is over 2,200 feet. The limestone country holds well, and square setting without filling is commonly employed. The mines are dry, and water for the camp has to be piped in. The district is served by the Rio Grande Western and by the San Pedro, Los Angeles and Salt Lake railroads. Many of the mines are now worked on the leasing system. The new plant of the Tintic Smelting Company is for lead ores only. All the copper ores are shipped without concentration. The presence of enargite and its oxidation products is a matter of economic significance in view of the recent decision enjoining the smelters in the Salt Lake Valley, where practically all the Tintic ores have been reduced, from treating ores containing any arsenic. Some of this ore is shipped to California works.

Frisco district.—The Frisco district, in Beaver County, is credited in 1907 with a production of about 4,900,000 pounds in the form of blister copper, though part of this was from materials mined in 1906. The output, most of which was from the Cactus mine, of the Newhouse Mines and Smelters was affected by restricted operations of that company after October.

The ore body of the Cactus mine[a] is an irregular mass of much crushed monzonite impregnated with pyrite, chalcopyrite, and various gangue minerals. By tunnel and winze the deposit had been opened to the 800-foot level by the end of 1907, and a large quantity of ore was exposed. The ore is of low grade, and over 90 per cent of it is concentrated about 8 or 9 into 1. The yield has increased recently, and for the year ending June 30, 1908, was about 2.05 per cent. Gold and silver amounting to about 35 cents per ton help to reduce the cost of production. At the start the deposit was stripped and the upper portion extracted by steam shovel, but this method has been discontinued, and all extraction is from underground, where a square-set and filling system is employed. Electric power transmitted from outside the district is to be employed extensively. Production was also secured from ores of contact-metamorphic deposits mined by other interests. Ores and concentrates are shipped to Salt Lake smelters over a branch and the main line of the San Pedro, Los Angeles and Salt Lake Railroad.

Other districts.—The Little Cottonwood district in Salt Lake County, the Ophir district in Tooele County, the Tutsagubet district in Washington County, the deposits at Copper Mountain in Boxelder County, and the Park City mines were the principal contributors to the State's copper production outside of the three districts already described. In some of these regions copper is recovered incidentally to the recovery of other metals. The Salt Lake Copper Company made important shipments of oxidized ore of good grade from its Copper Mountain property. The Utah and Eastern Copper Company in the Tutsagubet district produced matte and black copper from its Dixie mine at Shem. Copper-lead ores yielded much of the output from the Little Cottonwood district.

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[a] See Emmons, S. F., Bull. U. S. Geol. Survey No. 260, 1905, pp. 242–248.

OTHER STATES.

Alabama.—Alabama entered the list of producers in 1907 with a small output derived from leaching pyrite cinders. The Alabama Copper Company, of Montgomery, which had erected a plant for this purpose, received the cinders from fertilizer makers, who in turn derived the ores from pyritic deposits at Pyriton, Clay County. Cement copper, said to carry also some silver and gold, was produced and sold to various refineries on the Atlantic coast; but in September the plant burned, and has not since been rebuilt.

Georgia.—The small copper production of Georgia in 1907 came from copper-lead ore shipped from the Seminole mine in Lincoln County. The smelting equipment was not operated during the year. No production was made by the Georgia and Tennessee Copper Company, which made a small output in 1906.

Maryland.—A small quantity of copper-bearing concentrates was produced from the old Liberty mine in Frederick County during experimental work. They were treated at refining works on the coast. An important transaction of the year was the passage of the Baltimore Copper Smelting and Rolling Company into Guggenheim control in order to supply refining capacity for the Garfield, Tacoma, and Steptoe smelters.

Missouri.—The output of Missouri showed a decided increase over that of 1906. The matting furnace of the Missouri-Copper Mountain Company at Sullivan was not operated during the year. The North American Lead Company at Fredericktown, Madison County, made important production of blister and electrolytic copper, as well as of some nickel and cobalt, in its new plant. The ore, which occurs near granite and between limestone and the underlying sandstone, consists of chalcopyrite, galena, and a nickel-cobalt mineral. The ore is concentrated, with separation of the lead, and the copper-nickel-cobalt concentrates are treated by a process not made public. The company expects to increase its production.

North Carolina.—The production of blister copper from North Carolina ores in 1907 decreased to 544,040 pounds from 582,209 pounds in 1906. The Union Copper Company at Gold Hill, Rowan County, reduced production from its low-grade siliceous deposit in the fall of 1907. This ore was used as flux or converter linings at works in Tennessee and in New Jersey. Increased output came from the North Carolina end of the Virgilina district in Person and Granville counties, where quartz veins in schist carry primary chalcocite and bornite. Both crude ore and concentrates were shipped to the Eustis smelter at West Norfolk, Va., and to refineries farther north.

Oregon.—The blister production of Oregon in 1907 was 518,694 pounds, as compared with 545,859 pounds in 1906. The Takilma smelter, in Josephine County, was again able to operate for only a short period owing to the bad condition of the roads for the long haul to Grants Pass. The Oregon Smelting and Refining Company's plant at Sumpter, Baker County, was operated till October, treating ores from Oregon and from the Seven Devils district in Idaho. The matte from both these plants was handled at the Tacoma smelter, which also treated some Oregon ores. Smelters were started at the Iron Dyke property in Baker County, and at the Alameda Consolidated mines in Josephine County.

Vermont.—In 1907 the blister copper output from ores of Vermont was 696,102 pounds, as compared with 11,694 pounds in 1906. Some of the materials shipped from the mines in 1906 still remained unsmelted at the end of 1907. The production came from the well-known low-grade pyrrhotite deposits of Orange County, and was shipped out of the State as ore, concentrates, and matte. Magnetic concentration is practiced on some ores. The matte was produced by the new plant of the Vermont Copper Company. Final production as blister was made at various works on the Atlantic coast.

Virginia.—The list of copper-producing States was lengthened in 1907 by the addition of Virginia, with a production of 57,008 pounds of blister copper. A great part of this production was from deposits mined chiefly for ores of sulphur. At Dumfries, in Prince William County, chalcopyrite ore is sorted out from the pyritic material. A small matte furnace was built, but did not produce. Cement copper was produced from cinders of pyritic ore mined in Louisa County. A little ore was received at smelting works from the Seaboard Copper Company in the Virgilina district, but regular production by the new concentrating mill of that company was not begun in 1907. The large figures of copper production for Virginia in 1907 which have appeared are evidently due to inclusion of foreign material made into matte.

Washington.—The blister copper production of Washington decreased in 1907 to 122,263 pounds from 290,823 pounds in 1906. The difference between mine and smelter figures for 1907 is accounted for by the fact that some cupriferous fluxing materials shipped in 1907 were not treated during the year by the smelters. The principal output comes from Ferry and Stevens counties, from which ores carrying high sulphur are shipped to British Columbia works. Much activity was exhibited in smelter building. The following companies were constructing plants in 1907: Washougal Gold and Copper Company, Washougal, Clarke County; Byrne Mining and Smelting Company and Keller and Indiana Mining and Smelting Company at Keller, and the Colville Mining and Smelting Company at Republic, all in Ferry County; Bunker Hill Mining Company at Index, Snohomish County; and Elizabeth Mining Company at North Yakima, Yakima County.

Wyoming.—The production of blister copper from Wyoming in 1907 is given as 3,026,004 pounds, whereas in 1906 it amounted to only 106,177 pounds. The figures for 1907 include the production of one important company, on the basis of an unsatisfactory statement made by it. In seeking to verify the production thus reported, all known avenues of disposal have been searched, but the quantity of copper, creditable to this company, that was shipped, refined, stored, or exported is much less than that reported as produced. Some Wyoming ore was shipped to smelters in Utah and in Illinois.

The principal production was derived from the Encampment district of Carbon County, which is credited with a production of about 2,900,000 pounds. The mill and smelter of the Penn Wyoming Copper Company were rebuilt and were operated during part of the year.

The most important deposits[a] occur in fractured and jointed areas of quartzite. The rocks and probably the ores are of pre-Cambrian age. The primary ore minerals appear to have been pyrite and chalcopyrite, but secondary enrichment has caused the development of chalcocite and some bornite and covellite. These secondary minerals are becoming less abundant with depth. The ores previously worked have carried good values in copper and precious metals. Development has extended only a few hundred feet below the surface.

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[a] See Spencer, A. C., Prof. Paper U. S. Geol. Survey No. 25, 1904.

REFINERY PRODUCTION.

The production of refined copper in the United States in 1907 was made by 16 refineries,[a] of which 11 employ the electrolytic process. Eight of these electrolytic refineries are situated on tide water, 6 on the Atlantic coast, and 2 on the Pacific coast. Five plants are located on the Great Lakes and refine Lake copper, 4 (in Michigan) being furnace refineries, and 1 (at Buffalo) employing the electrolytic process in part. Three plants located respectively at Blue Island, Ill., Fredericktown, Mo., and Great Falls, Mont., are dependent on railroad transportation. The last two are electrolytic refineries. Both of the Pacific coast companies closed down the refining part of their works in 1907, owing to the small demand for refined copper on that coast and for export from western ports, and to the added fact that such demand as there is can be advantageously supplied by the Boston and Montana refinery, where cheap water power lowers the cost of refining.

Ten of these plants do a custom refining business, and the individual production of 5 of them is very large. The combined annual capacity of the electrolytic refineries at present in operation, or now building, which is over 1,200,000,000 pounds, appears ample to meet any immediate growth in smelter production of this country and of those countries which depend on American refineries. A refinery of considerable size at the old Anaconda smelter site can be put in commission if occasion arises. The Lake refineries, likewise, can handle considerably more material than they are now receiving.

CASTING COPPER.

Blister copper too low in precious metals to make their recovery profitable and carrying impurities in too small quantities to be especially objectionable is refined by the furnace process and cast mostly into ingots. This copper is generally of too low conductivity for use in electrical transmission and rather too impure to be desirable for brass making or rolling. Possessing certain desirable physical properties, however, it makes good copper castings, and is put mainly to this use.

Owing to the decreasing cost of electrolytic refining and the growing demand for copper of high conductivity, the relative importance of casting copper is gradually diminishing. If the excess in cost of electrolytic refining over the old furnace process averages $11 per ton, or 0.55 cents per pound, and if the price of casting copper ranges 0.25 cents lower than that of electrolytic, then about 0.3 cents per pound, or $6 per ton, in precious metals will practically pay the cost of electrolytic refining. The production of new casting copper in 1907 amounted to 16,592,684 pounds, of which 13,410,678 pounds was from domestic sources and 3,182,006 pounds was from foreign sources. The decline in production of domestic casting copper from 33,459,413 pounds in 1906 is largely due to the fact that, under the weak copper market prevailing during much of 1907, bids for casting copper were at prices decidedly lower—in certain cases 1 cent lower per pound—than for electrolytic, and under these circumstances it was to the producer's advantage to electrolyze his product, even if the precious metal yield were low, or else to export his blister for use without refining. The production of casting copper in 1906, on the other hand, had been stimulated by a rising market and strong demand for early delivery.

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[a] The statistics given in this section of the report are based on figures furnished the Geological Survey by each of these refiners.

Most of the new casting copper produced in 1907 came from the Morenci-Metcalf district in Arizona, and smaller quantities were derived from the Globe district, Arizona; Calaveras County, Cal.; and from Wyoming. Large quantities of blister containing low precious-metal value were exported unrefined from the Morenci-Metcalf district and from Ducktown, Tenn. Small quantities also went from California, Utah, and Missouri. This unrefined pig copper was probably used direct for casting purposes in Europe. The total quantity thus exported in 1907 was 42,350,963 pounds; the corresponding quantity in 1906 was about 9,700,000 pounds.

The regular refining companies produced from old and scrap copper 16,812,756 pounds casting copper in addition to the quantity stated above. Many plants throughout the country, and especially in the manufacturing centers of the East, rework the refuse copper from various industries. The refining process employed at most of these plants is comparatively simple and in many cases yields copper of somewhat inferior quality. This is partly sold as casting copper, but a considerable part of it is made directly into various alloys. It is, of course, impracticable to secure returns from all these metal-reclaiming companies, and in fact some do not keep accurate records. Requests for information were sent to some 300 of these companies, and returns were received from about 150. These returns indicate that 35,355,966 pounds of copper were turned out by such companies, as raw casting copper or worked up in alloys. The total production of secondhand casting copper in 1907 was therefore at least 52,168,722 pounds. The corresponding quantity produced in 1906 was estimated at 30,000,000 to 40,000,000 pounds. With the low copper prices now current, much less of this old copper is reclaimed.

The entire production of casting copper in the United States in 1907, both new and old, domestic and foreign, was at least 68,761,406 pounds.

LAKE COPPER.

The term Lake copper came into use to designate the output of the Lake Superior copper district of northern Michigan. Owing to the fact that this Michigan copper was fundamentally different in its natural state or occurrence from that of most other copper districts, it was amenable to a process of refining which was different, both in operation and in standards of excellence, from the methods employed in refining copper from other regions. The consequence was that this Michigan product was of somewhat different character and quality from the copper produced elsewhere. The term Lake copper, therefore, in addition to its purely geographic significance soon came to imply a particular grade or quality of copper, and it is undoubtedly in this double sense that the term has generally been used. So long as the actual character of this Michigan copper remained different and distinct from that of other copper, this dual significance of the term Lake copper caused no confusion. But with changing conditions that have affected both the Lake Superior product and that from other districts, the early and established meaning of the term has been so warped and expanded that now in many cases it is impossible to decide from the name alone just what so-called Lake copper really is. In view of the large production and well-known reputation of this grade of copper, a few paragraphs relative to this evolution of Lake copper may be permissible.

The native copper of the Lake Superior district occurs commonly in the crystalline state and, compared with most native copper from other localities, is unusually pure, even as it comes from the mine. The so-called Lake process of refining is, therefore, essentially only a separation, by fusion, of materials which had not been eliminated by gravity from the stamp-mill concentrates. Variations are required for the treatment of the leaner concentrates, for the retreatment of the slags and to meet other more or less important conditions, but the bulk of the copper is obtained simply by a melting, followed by rabbling, poling, and, finally, casting.

Two at least of the oldest producers of Lake copper, the Calumet and Hecla and the Quincy companies (these two were for many years and were in 1907 the largest single producing mines) had always given particular attention to the refining of their copper, and for years the refining of these two companies was done by members of one family who had entered this business practically at the beginning of the Lake refining industry. With a material to work upon which was but little contaminated with impurities, the exercise of particular care in the refining produced a copper which was found to be distinctly superior to either the old furnace-refined product or, later, to the electrolytic product from other sections of the country. While it is hardly to be doubted that the quality of copper turned out by these two, and possibly some other companies, virtually established the enviable reputation of all Lake copper, it is almost equally certain that in the days when the electrolytic process was applied primarily for the recovery of the precious metals Lake copper as a whole was actually a better and more dependable product than the average electrolytic copper. It is possible that a slight percentage of arsenic that clung to the copper through the refining process was in part responsible for this superiority of Lake copper, since, though this element reduces the electrical conductivity of the copper, it increases the tensile strength.

With the opening of new lodes and with the mining from deeper levels of certain of the older lodes it was found that some of the Lake copper was too high in arsenic to be desirable for electrical transmission. It was also found that for numerous uses in which ductility of the metal is of chief importance, such as the finest gages of wire, flat-head rivets, brass for deep-drawing, etc., certain brands of Lake copper were not so well suited as others; care in rabbling, poling, and casting, as well as the arsenic content, may have been partly responsible for this difference. At any rate it came to be recognized that the brands turned out by certain Lake mines or refineries were of such quality and uniformity as to be more valuable and desirable than the rest of the Michigan output. Although so far as known these better grades have always been designated in the trade only by the brands corresponding to the names of the companies that produce them, they have come to be referred to collectively and in a general way as best Lake copper.

It is believed that the arsenic encountered in Lake copper is originally present to some extent in the copper itself, but that probably a larger proportion is contained in the surrounding rock or gangue. From the same lot of ore the finest sizes of concentrates generally yield copper containing the most arsenic. Whether this is due to the fact that the finer concentrates carry a larger proportion of gangue, from which the arsenic is taken up by the copper in the smelting process, or whether the arsenical copper is more brittle and breaks finer during crushing, or whether there is some other cause, does not appear to have been determined as yet.

In order to eliminate as much arsenic as possible, the smaller sizes of mineral and the arsenical portions of the coarser mineral are at some plants subjected to additional smeltings; but even with unusual precautions the last portions of this element can not be removed by the furnace process with commercial economy.

Notwithstanding increasingly rigid requirements by the principal copper consumers, particularly concerning conductivity, and in spite of a growing percentage of arsenic being met with in some of the mines, many of the Lake producers have been able to hold to the furnace-refining process solely. Certain companies, however, have deemed it advisable to adopt further means for maintaining or improving the quality of their product, and application in some way of the electrolytic process has seemed to be the only feasible plan. It is interesting to compare the ways in which this plan has been put into practice. The Copper Range and Isle Royale companies, producers of low-conductivity copper, ship a portion of their product as anodes to be electrolytically refined in New Jersey. (Some electrolytic copper is also produced from the Quincy mine, but this is for the sake of silver recovery and not for separation of arsenic.) The Calumet and Hecla Company and the Lake Superior Smelting Company[a] handle copper from different lodes and of different degrees of purity. These companies found that by the furnace process they could produce a part of their product almost pure enough to be classed as best Lake copper, but that a portion of their product, holding an accumulation or concentration of arsenic, was of poorer grade. Both companies resorted to the plan of diluting the arsenic in the better portion of their product by the addition of enough of a practically pure copper to bring the resulting mixture up to the requisite grade. The Calumet and Hecla Company secures this arsenic-free diluent, and at the same time brings the whole of its output to substantially the same grade by electrolytically refining the most arsenical and the most argentiferous portions of its mineral and mixing the cathodes with the other mineral. The Lake Superior Company disposes of its most arsenical copper by selling it under the Isle Royale brand, since the copper from that mine itself is known to be arsenic; their arsenic-free diluent is secured in the shape of electrolytic cathodes made from Montana and Idaho copper by the Boston and Montana Company at Great Falls, Mont. Both companies are able to accomplish this improvement in their product without any increase in cost, but rather at some profit. In the case of the Calumet and Hecla Company the cost of electrolyzing and of melting and casting the cathodes (mixed with the purest mineral) is more than made up by the value of the silver recovered and the profits on custom refining. The Lake Superior Smelting Company handles the Boston and Montana cathodes at a charge which provides for a small profit, and of course there is a profit—represented by the difference in price between Lake and electrolytic copper—in selling this western electrolytic copper under the Tamarack and Osceola brands.

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[a] This company does the smelting for the Tamarack, Osceola, Ahmeek, and Isle Royale mines.

It is apparent, therefore, that the commodity sold as Lake copper is derived from several parts of the country, is the product of various unlike processes, and varies between wide limits as to quality. Lake copper as sold in the year 1907 comprised the following:

1. A great part of the Michigan output that was refined by the regular Lake refining process, and represented part or all of the output of most of the Michigan mines. This copper, however, ranges from at least 101 per cent to less than 50 per cent electrical conductivity, and is not, therefore, of a particular or characteristic grade or quality,[a] but instead includes copper suitable for the most exacting uses and copper of comparatively inferior properties.

2. A large quantity of copper, being part of the output of the Calumet and Hecla Company, that consisted of a mixture of Lake refined copper with about an equal quantity of electrolytic cathodes derived from Lake refined anodes. This copper is regarded as of the highest quality.

3. A large quantity of copper that consisted of Lake refined copper—the greater part of the product of the Tamarack, Osceola, and Ahmeek companies—mixed with about an equal quantity of electrolytic cathodes derived from Montana and Idaho ores that had previously been through the matte-smelting and converting processes. The quantity of western cathodes amounts to about 10 per cent of the entire quantity of metal sold as Lake copper. This mixed Michigan and western copper is also regarded as of high grade.

4. A quantity, as yet comparatively small, being part of the output of the Quincy, Isle Royale, and Copper Range mines, that was made into anodes at the Lake smelters, and then converted into electrolytic copper at plants in other States. This copper is, of course, high in conductivity and practically pure, like electrolytic copper generally. It is not certain that the whole of this copper was put on the market as Lake copper.

Obviously, in the compilation of statistics showing the production of Lake copper it must be decided which of these four groups shall be included. The copper included in the first, second, and fourth groups, but only part of that in the third group, is mined in the Lake Superior district. The copper of the second, third, and fourth groups, but only part of that in the first group, is of good grade. It is probable that some of the electrolytic copper of the last group, though mined in Michigan and of high grade, was sold as something other than Lake copper. The copper of the first group only is refined entirely by that process which has been supposed to be necessary to maintain in the finished product those particular properties which until recently were believed to characterize the Michigan copper in its natural state, and to distinguish the Michigan product, when so refined, from the copper produced elsewhere.

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[a] Certain statistics of Lake copper that have been published recently make a division into "Prime Lake" and "Arsenical Lake." The arsenical class seems to consist of the combined total output of the Copper Range and Isle Royale mines, and the remainder of the Michigan output constitutes the "prime" division, which probably is meant to represent the best brands of Lake copper. These statistics apparently disregard the facts that a considerable portion of the ouput of the Copper Range and Isle Royale companies is electrolytically refined and that other companies produce and sell distinctly arsenical copper.

If, as seems inevitable, the practice of electrolyzing or mixing with electrolytic copper is to be extended to a much larger part of the Michigan output than at present, the confusion arising from the use of the term "Lake copper" is certain to increase. Producers of arsenical Michigan copper will electrolyze their product, and, rather than cope with the reputation of producing arsenical copper, will sell their output as electrolytic copper. On the other hand, much greater quantities of electrolytic copper from Montana or any other region may be brought in to improve the grade of nonelectrolytic Michigan copper.

In this review of the copper industry in the United States, both in the present report and in that for the preceding year, a certain basis has been taken for the computation of Lake copper production, but in view of the complexity of the case, the basis decided upon is by no means satisfactory, though it is believed to be as expressive as any other that could be chosen. Lake copper as used in this report is taken to be that part of the output of Michigan mines that is refined by the furnace process, according to the long-established practice of the region. It is independent of the quality of the metal produced and of whether or not there may be added to it electrolytic copper from Michigan or elsewhere.

Statistics covering all phases of this complex matter have been received by the United States Geological Survey for the last two years at least, but, inasmuch as the information was furnished confidentially and consequently could not be published directly, no adequate explanation of the basis of the statistics used could be given in the last year's report. Recently, however, much of this information has been made public, but no change in the methods of compilation seems justified.

The production of refined Lake copper—that is, nonelectrolytic Michigan copper—in 1907 was 178,534,141 pounds. In 1906 the production was 205,608,382 pounds. As already pointed out, part of the output in both years was mixed with electrolytic copper and sold under the brands of Michigan companies. The greater part of this Lake copper was cast into ingots and ingot bars, but some was made into wire bars and cakes. In addition to the quantities given, 40,588,362 pounds in 1907 and 24,087,348 pounds in 1906 were cast into anodes for electrolytic refining. From Michigan anodes 34,917,988 pounds of electrolytic copper were produced in 1907, as against 24,017,833 pounds in 1906. The difference of over 5,000,000 pounds between the anode production and the electrolytic output in 1907 is partly accounted for by loss in the electrolysis, but is mainly represented by stock of unfinished material accumulated at electrolytic works. As previously pointed out, part of this Michigan electrolytic copper was mixed and sold with Michigan nonelectrolytic copper, while a part was sold unmixed. The total copper from Michigan mines refined in 1907 was 213,452,129 pounds; in 1906 the quantity was 229,626,215 pounds. The total quantity of refined Michigan copper plus the western copper that was mixed with some of it amounted to between 230,000,000 and 235,000,000[a] pounds in 1907, and between 255,000,000 and 260,000,000[a] pounds in 1906.

The silver recovered by electrolysis amounted to about 0.008 ounce, or, at the average price of silver for the year, about 0.55 of a cent per pound of copper electrolyzed. In 1906 the yield was slightly greater, namely, 0.009 ounce per pound. While the aggregate quantity of silver recovered is certain to increase with widened application of the electrolytic process, the ratio of silver to copper will probably decline somewhat.

The old contention as to quality of product between the producers of Lake copper and those of electrolytic copper has recently been aired and apparently settled. As already stated, because the Michigan copper was, in its natural state, very nearly pure, whereas the copper from most other districts was contaminated with some of the deleterious elements, such as sulphur, arsenic, antimony, bismuth, etc., the Lake copper, with its advantage of undoubtedly better handling in the removal of cuprous oxide, was in the early days of the American copper industry commonly recognized as a superior article to the general run of copper from other regions. When the electrolytic process practically displaced the old furnace methods of refining, the main object was to recover the precious metals contained in the bullion, and the quality of the copper produced was a distinctly secondary consideration. The electrolysis itself was reasonably satisfactory as to results, producing cathodes of great purity, but in the almost equally important matter of the "pitch" or oxygen content of the metal, the electrolytic refiners seem to have been behind their competitors at the Lake. Some electrolytic refiners turned out much good copper, but an occasional bad lot would establish the reputation of the whole. The remarkably high standard constantly maintained by certain of the Lake companies, and the generally good quality of all the Michigan copper, in the days when the requirements of producers were less strict and when less arsenic was being encountered than at present, permitted Lake copper to retain over electrolytic copper the advantage it had held over other copper when refined by the older furnace methods. This superiority was so distinct that it came to be regarded as due to some inherent difference in the physical properties of copper from the Michigan lodes as distinguished from those of other copper. It was known that the slight percentage of arsenic contained in the Lake copper increased its tensile strength. It was believed, also, that because the Michigan copper occurred naturally in the native, crystalline state, it possesed advantages, when properly refined, over copper that had to be reduced from compounds which, if crystalline at all, possessed different molecular or crystal structure from that of pure copper. And it was thought that the simple process of melting to which this Lake copper was subjected did not destroy this desirable structure of the raw material, but permitted it to be duplicated or retained in the castings of refined copper. The toughness and strength of Lake copper were attributed in large part to this structure.

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[a] The Survey is not at liberty to publish the exact figures.

The electrolytic producers first doubted and then denied that such differences between Lake and electrolytic copper actually existed, and with improving quality of the electrolytic product they were able to compete with the Lake producers on nearly equal terms. But up to the present the best brands of Lake copper have been able, under most conditions of the market, to obtain a slight premium over the price paid for electrolytic. The fact recently made public that a large portion of best Lake copper as sold consists really of electrolytic in part causes one to suspect that this advantage enjoyed by the Lake producers is the result of sentiment or custom and is based rather on past reputation than present merit. This suspicion is strengthened by the recent testimony of several important consumers of copper, including officers of the technical and operating divisions of the American Brass Company, which is probably the largest single consumer of copper in the world. These consumers stated that they were able to use the best brands of Lake copper and the best brands of electrolytic indiscriminately for all purposes. If further confirmation were necessary it might be found in the fact that, although the specifications of the United States Navy have prescribed best Lake copper for use at the yards in making brass cartridges (a use supposed to require the very best quality of copper), a test lot of electrolytic copper made into cartridges at the Washington Navy-Yard in 1907 gave better results than had ever before been attained with any copper. This copper was from mixed western blister transformed into cathodes at the Chrome (N. J.) plant of the United States Metals Refining Company, and cast at the Buffalo works of the Calumet and Hecla Company.

It is certain that the price paid for copper by the principal consumers of the country is based on the results of chemical and physical tests, and it seems without doubt that the necessary and essential things in production of the best copper are the elimination of impurities, the proper content of oxygen, and care in casting, rather than derivation from any particular section of the country.

In view, therefore, of the complexity of so-called Lake copper, as to source, preparation, and quality, and of the fact that even the best Lake copper is best only because it has been treated by methods that can be applied just as satisfactorily to electrolytic copper, it would appear that the term Lake copper has about outlived its usefulness, and, having now little meaning as a trade designation, it seems likely that as conditions in Michigan change still more, the term will gradually fall into disuse.

ELECTROLYTIC COPPER.

The quantity of electrolytically refined copper produced in the United States in 1907 from domestic materials of primary origin was 592,326,608 pounds, as compared with 648,614,592 pounds in 1906. This was produced mainly by the refining of blister or converter copper, but 34,917,988 pounds in 1907 and 24,017,833 pounds in 1906 were derived from anodes of Michigan copper refined for purification or for silver content. The year's production of the electrolytic refineries from domestic material of secondary sources was 8,316,861 pounds, as compared with 15,382,129 pounds in 1906. Materials of foreign origin electrolytically refined in 1907 in the plants of this country yielded 245,062,814 pounds, as against 191,370,022 pounds in 1906. The total output of electrolytic copper by American refineries during the year 1907 was therefore 845,706,283 pounds, of which 837,389,422 pounds was from primary sources.[a] In 1906 the total electrolytic production was 855,366,743 pounds, of which 839,984,614 pounds was from primary sources. The cathodes resulting from electrolysis are commonly melted and cast, acording to specifications of the buyer, into wire bars, ingots, cakes, or other forms.

In addition to the 845,706,283 pounds of electrolytic copper, the refineries turned out approximately 8,466,630[b] pounds in the form of bluestone. This quantity of copper, which is about 1.04 per cent of the total copper subjected to electrolytic refining during the year, virtually represents the loss attendant upon this process, and indicates an average recovery of about 99 per cent of the copper received. An average recovery higher than this certainly could be made, and probably would be made if the bluestone were not a product which generally commands a good price and if it did not afford by its formation certain advantages of internal operation, as, for example, the neutralization of excess sulphuric acid in the electrolyte.

The 245,062,814 pounds electrolytic copper from foreign sources was derived in part from 64,145,648 pounds blister produced from foreign materials in domestic smelters and in part came from imported foreign blister containing about 183,530,132 pounds and imported old copper containing about 6,828,877 pounds. This blister was imported principally from Mexico and Canada, but some came from Australia, Japan, Peru, and several other countries.

The recovery of gold and silver by the electrolytic refineries in 1907 was very large, but in the absence of statistics on this point from one important company accurate figures can not be given.

TOTAL REFINED COPPER.

The total production for the year 1907 of refined new copper from material originating in the United States was 784,271,427 pounds, comprising electrolytic, Lake, and casting copper, as shown in the following table, which also gives the output from foreign materials and comparative figures for 1906:

Production of refined new copper in 1906 and 1907, in pounds.

	1906.		1907.	
	Domestic origin.	Foreign origin.	Domestic origin.	Foreign origin.
Electrolytic	648,614,592	191,370,022	592,326,608	245,062,814
Lake	205,608,382		178,534,141	
Casting	33,459,413		13,410,678	3,182,006
Total	887,682,387	191,370,022	784,271,427	248,244,820
Total output domestic refineries	1,079,052,409		1,032,516,247	

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[a] A small part of the foreign product was derived from old and scrap copper. The weight of this material was 7,188,292 pounds (see table, page 69) and the estimated yield of refined copper was 6,757,857 pounds. This is new material, so far as consumption in this country is concerned, and hence is classed with copper of primary origin.

[b] See under heading "Copper sulphate," page 66.

As already pointed out, the figures for domestic electrolytic include 34,917,988 pounds in 1907 and 24,017,833 pounds in 1906 of Michigan copper that was electrolyzed. Second-hand material is excluded.

The decrease of 103,410,960 pounds, or 11.6 per cent, from the domestic production of refined copper in 1906 is explained by a decrease in smelter production in 1907, part of which took place early enough in the year to reduce the refinery output; by an accumulation of about 40,000,000 [a] pounds of blister and unfinished materials; and by a difference of over 32,000,000 [b] pounds in exported blister.

The following table shows the source of the refined new copper produced in 1907 from ores mined in the United States. This distribution has been made possible by the possession of complete smelter statistics showing both sources of receipts and shipments to the various refineries, by carefully compiled data from the refining companies giving derivation of materials treated and, in the case of works that accumulated much unfinished material, by inventories of the stock of unfinished material on hand from each State. The figures of refinery production for each State must be regarded as only approximate because of differences of stock between smelter and refinery that can not be estimated, but any error arising from this source will be slight and will be rectified if the statistics are continued over a series of years. For comparison, the smelter production of each State is also given.

Production of refined new copper in 1907, by States, in pounds.

State.	Smelter production.	Refinery production.	
	Blister, Lake, etc.	Electrolytic.	Lake and casting.
Alaska	7,034,763	6,748,610	
Arizona	256,778,437	207,361,719	11,561,331
California	33,696,602	33,642,183	997,432
Colorado	13,998,496	13,661,290	
Idaho	9,707,299	9,410,234	
Michigan	219,131,503	34,917,988	178,534,141
Montana	224,263,789	201,186,179	
Nevada	1,998,164	1,968,617	
New Mexico	10,140,140	10,085,758	
North Carolina	544,040	480,372	
Oregon	518,694	513,867	
Tennessee	19,475,119	8,131 457	
Utah	66,418,370	60,993,508	
Vermont	696,102	697,661	
Virginia	57,008	56,640	
Washington	122,263	121,177	
Wyoming	3,026,004	674,744	24,106
Alabama, Georgia, and Maryland	90,655	89,085	
Missouri and unapportioned	1,299,043	1,585,519	827,809
Total	868,996,491	592,326,608	191,944,819
Total refined		784,271,427	

If to this domestic production of refined new copper is added the quantity of unrefined blister exported—which, so far as can be ascertained, is consumed directly in Europe—the contribution made by the copper deposits of the United States to the supply of copper ready for consumption was 826,622,390 pounds, or 52 per cent of the world's total smelter production in 1907, as compared with about 897,382,387 pounds, or 56.2 per cent, of the world's total smelter production in 1906. Add to the domestic production the yield from foreign materials refined in this country, and it appears that metallurgical plants in the United States prepared for the market in 1907 about 67.6 per cent of the copper produced by all the smelters of the world, and about 68.2 per cent in 1906.

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[a] See page 67.

[b] See page 57.

The regular copper refining companies produced in 1907 from old copper, scrap, trimmings, etc., 25,129,617 pounds, of which 8,316,861 pounds was electrolytic and 16,812,756 pounds was casting. The metal-reclaiming companies produced in addition from such secondary sources at least 35,355,966 pounds of casting copper. The copper produced from secondary sources in 1907 was therefore over 60,000,000 pounds, or more than 7.5 per cent of the year's production of refined new copper. The total production in the United States of all refined copper, domestic and foreign, new and old, was at least 1,093,001,831 pounds, divided as follows: Electrolytic, 845,706,283 pounds; Lake, 178,534,141 pounds; casting, at least, 68,761,406 pounds.

COPPER SULPHATE.

The quantity of hydrous copper sulphate, or bluestone, produced as a by-product in the electrolytic copper refineries in 1907 was about 33,464,950 pounds,[a] having a fine copper content of 25.3 per cent, or about 8,466,630 pounds. In 1906 the production of bluestone was about 42,252,500 pounds, containing about 10,689,880 pounds of copper. The conditions of production of this material have already been referred to under the heading of electrolytic copper. The bluestone plant of the Arizona Copper Company continued idle during 1907, and so far as known no other bluestone was recovered during the year in the copper-producing industry, the copper sulphate in mine waters and from leaching processes having been converted into metallic copper by precipitation with iron scrap or electrolytically.

STOCKS.

Returns have been received from all the refineries showing the stocks of refined copper on hand at the beginning and the end of the year 1907. From two companies approximate data only were received. The figures are as follows:

Stocks of refined copper, in pounds.

January 1, 1908	125, 745, 796
January 1, 1907	46, 497, 181
Stock accumulation during 1907	79, 248, 615

Undelivered sales are almost entirely excluded from these figures. Stocks carried by consumers and brokers have not been estimated. Consumers' stocks were undoubtedly reduced during the year. Of the stocks tabulated, about 8,000,000 pounds on January 1, 1907, consisted of Lake copper, and on January 1, 1908, stocks unsold by Michigan companies amounted to 25,985,449 pounds, of which about 4,000,000 pounds was electrolytic.

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[a] About 1.5 per cent of this quantity is estimated.

In addition to these stocks of refined copper, there were at smelters, in transit to refineries, and at the refineries, blister copper and material in process of refining to the amount of 135,310,239 pounds on January 1, 1907, and of 175,254,659 pounds on January 1, 1908, an accumulation of about 40,000,000 pounds.

Such data as are available indicate that there was no important change in stocks held by the metal-reclaiming companies or second-hand refiners, these companies greatly reducing production when consumption and price fell.

IMPORTS AND EXPORTS.[a]

IMPORTS.

The total quantity of copper in unmanufactured form imported into the United States in 1907 was 253,523,682 pounds, according to records of the Bureau of Statistics of the Department of Commerce and Labor. The corresponding imports in 1906 were 225,593,281 pounds, and 210,724,685 pounds in 1905. The source of these imports is shown in the following table:

Imports of copper into the United States, 1905-1907, by countries, in pounds.

Country.	Ore, matte, and regulus (copper content).			Pigs, bars, ingots, plates, old, etc.		
	1905.	1906.	1907.	1905.	1906.	1907.
United Kingdom				26,284,302	22,549,321	25,706,852
France				1,549,138	3,202,168	606,662
Germany				2,945,441	5,303,712	6,814,338
Other Europe				1,955,358	5,649,689	5,616,261
British North America	15,403,429	10,329,955	12,803,069	23,636,843	30,398,369	30,902,596
Mexico	28,890,239	31,690,058	33,476,046	102,646,343	85,595,359	76,741,532
Cuba				433,440	513,240	767,184
Other West Indies and Bermuda				278,502	399,569	401,585
South America	1,503,427	4,140,589	8,685,621	(a)	(a)	(a)
Japan					6,752,486	9,809,569
Other countries	4,308,205	2,874,289	5,657,679	890,018	16,194,477	35,534,688
Total	50,105,300	49,034,891	60,622,415	160,619,385	176,558,390	192,901,267
Grand total				210,724,685	225,593,281	253,523,682

[a] Included with "Other countries." Beginning with 1908, Peru will be given separately.

It should be noted that the British North American imports for 1907 include the approximate equivalent of 2,919,751 pounds as matte and of 1,265,260 pounds as blister, both of which were produced in Canadian plants from materials originating in the United States. The Mexican imports for 1907 similarly contain 8,809,788 pounds as blister made from domestic materials. The figures of these countries for 1906 also include comparable but somewhat smaller quantities of domestic material.

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[a] The degree of accuracy of some of the statistics in this section is unfortunately lessened by the inability to obtain from the custom-house classifications all the information desired regarding imports and exports of copper. The failure of the customs reports to distinguish with adequate precision those metallic products in the refined state from those which require refining, the absence of any division for cupriferous concentrates or for the copper contained in pyrite, and the lack of data on copper content of exported ores, concentrates, and matte, reported separately, necessitate the making of estimates based on whatever independent information is available.

It should be stated, however, that the classification at present in effect is imposed on the customs service by the wording of the tariff law, which dates back to the early days of American copper metallurgy. Revision of this wording is now being urged, and it is hoped that it will soon be possible to gain from the custom-house records statistics giving more specific information as to the matters most vital to the copper industry.

Since all unmanufactured copper is free of duty, movements of the material are not so strictly accounted for as of dutiable products like lead and zinc. The copper content of ore, matte, and regulus, for example, is not determined by the customs officials; instead, the figures supplied by the importers are accepted and hence are liable to inaccuracy. It appears probable that the figures for 1907, viz, 60,622,415 pounds, are considerably too low, since, even though they do not allow for loss on smelting, they are more than 3,500,000 pounds below the year's actual recovery in domestic smelters from these foreign materials, which was 64,145,648 pounds,[a] and this in a year when the smelters tended to accumulate rather than to deplete stocks. In 1906 the total reported copper contents of the ore, matte, etc., imported was similarly nearly 5,000,000 pounds lower than domestic smelters produced from such material. Numerous specific instances also appear, when import figures are compared with the output of metallurgical works,[b] which show that the figures of imports for ore, concentrates, and matte are inclined to be too low. Furthermore, no attempt is made at the ports of entry to ascertain the copper content of pyrite imported for sulphuric acid manufacture, although it is known that an appreciable quantity of copper is recovered by smelting the cinders from this material. In the case of blister and old copper, however, the weight is determined at the ports, and the gross weight of these materials, viz, about 192,900,000 pounds, compares closely with the copper contents of the same materials received by the smelters, viz, about 190,360,000 pounds, and indicates that the blister and old copper contained about 98.7 per cent fine copper.

Several facts worthy of mention are reflected by the foregoing table. The 11,000,000 increase in materials imported for smelting and converting is probably to a large extent a result of the stimulus of high prices to comparatively small foreign mines. The gain in the importations from British North America is due to the increased quantity of Alaska ore smelted in Canada and returned to this country in the form of matte. Blister copper, which constitutes over 95 per cent of the materials classed as "pigs, bars, etc.," again shows a gain in importations of about 16,000,000 pounds. The most important changes are the decline in Mexican importations, due mainly to the reduced output from Cananea and the increase from "Other countries," the greater part of which is due to the larger production of the Cerro de Pasco mines. It is of interest to note that imports of blister for December, 1907, dropped to about half the average monthly volume.

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[a] See page 15.

[b] In the case of one country the combined receipts of ore and matte in 1907 by three Atlantic coast plants were more than double the total reported imports from that country for the year. Another indication that the import figures are too low is found in the following facts: Imports reported for the twelve months November, 1906, to October, 1907, inclusive (which is practically the period during which receipts are drawn that appear as refinery output for the calendar year), were about 5,750,000 pounds less than for the calendar year 1907. The weight of blister plus the gross copper content of ore and matte on which the refineries had to work was therefore less than 248,000,000 pounds. Inventories of foreign material unfinished at several refineries and data from other sources indicate that the refineries accumulated during the year over 9,000,000 pounds of unfinished material from foreign sources, yet they actually turned out over 248,000,000 pounds of foreign refined copper. It seems certain that the receipts at refineries during the year must have been distinctly greater than the custom-house figures would indicate. When imports of refined copper are taken into account, a discrepancy of the same kind is found to exist for 1906.

An interesting movement took place in the spring of 1907, when, owing to the fact that quotations here were being kept at a high figure, copper of "standard" and casting grades held by speculators abroad was shipped to this country, subjected to electrolysis, and put on the market at a price somewhat lower than that asked by the principal agencies here. So far as can be reliably ascertained, no refined copper was so imported that did not pass through refineries in this country and thus become a part of the output reported by them. While much was made of this movement at the time it occurred, with the idea of influencing the market, it is probable that the actual quantity of copper so imported was really very small.

The actual additions to the domestic supply of copper by importation can only be properly gaged when the imports are expressed in terms of the refined copper which they will ultimately yield. In the table which follows the imports are divided according to classes of materials. In the case of the metallic products the actual weight of the material is given, whereas of the ores, mattes, and other lower grade materials the copper content is recorded and is open to the inaccuracy already mentioned. In the third column under each year careful estimates are given of the quantity of refined copper to which they are equivalent. These estimates are based on the average tenor of the materials, which can in most cases be ascertained from the complete custom-house records, and on the average metallurgical losses which such materials suffer. The imported matte and blister containing copper of domestic origin have been deducted from the proper items of the table.

Foreign imports in terms of refined copper, in 1906 and 1907, in pounds.

Materials.	1906.			1907.		
	Copper contents.[a]	Weight.[a]	Estimated yield in refined copper.	Copper contents.[a]	Weight.[a]	Estimated yield in refined copper.
Ore	27,169,220		24,988,524	42,993,417		40,291,333
Matte	11,411,878		11,173,062	[b]14,709,247		14,337,926
Regulus, and black and coarse copper	1,775,685		1,738,527			
Old copper, clippings, etc.		6,626,919	6,487,226		7,188,292	6,757,857
Pigs, bars, plates, ingots, etc.:						
Unrefined		140,770,190	137,824,449		[c]174,488,945	170,084,146
Refined		28,191,053	28,191,053		(d)	(d)
Yield from imported pyrite		(e)	5,000,000		(e)	[f]6,560,058
Total			215,402,841			238,031,320

[a] The figures in these columns are deduced from records of the Bureau of Statistics.

[b] Excludes 2,919,751 pounds contained in matte imported, but made from domestic ores.

[c] Excludes 995,555 pounds foreign material reexported and the weight of blister containing 10,075,048 pounds that was imported, but made from domestic ore and matte.

[d] Import records, and comparison of them with refinery figures indicate that no refined copper was imported into this country in 1907 except that which was again refined in domestic refineries, and is therefore included under "pigs, bars, etc., unrefined."

[e] No account is taken in the customs statistics of the copper contained in imported pyrite.

[f] Actual yield.

EXPORTS.

The exports of domestic metallic copper from the United States in 1907 amounted to 508,929,401 pounds, as compared with 454,752,018 pounds exported in 1906, according to figures compiled by the Bureau of Statistics. Although this is an increase of more than 50,000,000 pounds over the quantity exported in 1906, it is nearly 50,000,000 pounds below the record export figures of 1904. In addition to these exports in metallic form the copper contents of 99,141 long tons of ore, matte, and regulus were exported in 1907, as against 47,619 long tons in 1906. A small quantity of foreign material, 995,555 pounds, of unrefined bullion, was reexported. The accompanying table shows the movements of copper from the United States to the various countries in 1905, 1906, and 1907:

Exports of domestic copper from the United States in 1905, 1906, and 1907, by countries.

Country.	Ingots, bars, plates, and old (pounds).			Ore, matte, and regulus (gross weight in long tons).		
	1905.	1906.	1907.	1905.	1906.	1907.
United Kingdom	60,945,794	55,097,670	81,409,441	50	206	200
Belgium	4,997,206	6,475,054	3,822,551	....	....	....
France	74,604,044	80,703,723	93,075,145	....	....	....
Germany	104,575,864	96,629,040	107,607,390	....	59	188
Italy	15,800,967	19,777,296	21,192,908	....	....	....
Netherlands	130,675,386	151,650,293	156,652,270	....	....	....
Russia	18,418,982	9,523,992	4,341,386	....	....	....
Other Europe	25,279,152	25,260,807	26,221,024	....	....	....
British North America	3,019,450	4,176,135	3,747,410	24,690	36,700	82,016
Mexico	290,763	263,319	362,411	12,948	10,600	16,737
Chinese Empire	79,940,250	4,932,128	10,003,592	....	....	....
Other countries	16,359,751	262,561	493,873	....	....	....
Total	534,907,619	454,752,018	508,929,401	37,688	47,619	99,141

The increase in metallic exports in seen to have been to the principal consuming countries of Europe, and took place to a great extent as a result of the low prices during the last three months of the year. The exports for the month of November, as shown in the table on page 75, amounted to over 85,000,000 pounds. China again made considerable purchases for speculative purposes, though to nothing like such an extent as in 1905. Decreasing exports to Russia may be attributed in part to growing copper production in that country. The increased exports under the heading of ore and matte is largely accounted for by greater shipments of Alaskan ore and low-grade fluxing materials from Washington to Canadian smelters and increased movements of siliceous ore from Arizona and matte from Texas to smelters in Mexico.

To ascertain the extent to which the year's exports lowered the supply of copper in the country available for consumption it is necessary to determine the exports of refined copper. Since domestic materials in a stage of treatment lower than the metallic state do not affect the supply of marketable copper, exports of domestic ore, matte, and regulus need not be considered in this connection. Subtracting from the totals for "pigs, bars, etc.," the weight of blister, which was exported without refining and which contained 42,350,963 pounds in 1907 and about 9,700,000 pounds in 1906, it is found that the exports of refined copper amounted to 465,496,007 pounds in 1907 and 446,750,711 pounds in 1906. From information furnished by producers and brokers the division of exports for 1907 is made approximately as follows: Electrolytic, 428,000,000 pounds; Michigan nonelectrolytic, that is, Lake copper, 29,000,000 pounds; casting, 8,500,000 pounds.

CONSUMPTION.

The consumption of refined new copper in the United States in 1907 was about 485,000,000 pounds, a decrease of over 29 per cent from the record consumption—685,000,000 pounds—in 1906. The great reduction is, of course, explained by the financial history of the year. Whereas the consumption of 1906 was over 77 per cent of the domestic production of refined new copper and over 76 per cent of the production of refined new copper plus unrefined blister exported, in 1907 the consumption was less than 62 per cent of the total refined production of domestic origin and less than 59 per cent of the domestic refined output plus domestic blister exported unrefined. In other words, foreign countries secured more than 41 per cent of the product of our copper mines in 1907, as compared with less than 24 per cent in 1906. The consumption of new copper in this country in 1907 was 30.5 per cent of the entire world's production for the year. In 1906 it was nearly 43 per cent of the world's production.

Unfortunately there exists no feasible way of ascertaining directly the consumption of copper in the United States. Experience has shown that little dependence is to be placed on estimates based on assumed monthly consumption, with sometimes an arbitrary addition or deduction supposed to compensate for unusual conditions. The indirect method of deducting from total available supply the quantity withdrawn from supply and letting the difference represent consumption is undoubtedly more accurate, providing the component data are reliable. In the case of withdrawals from supply there is little difficulty, but the data for total supply are somewhat less satisfactory, and information from independent sources affording opportunity for comparison and discrimination is therefore to be welcomed. Data of total supply, independent in large measure, can be gained from the refinery statistics and from the imports reported by the Bureau of Statistics. The two methods of arriving at total available supply are shown in the accompanying tables, and give figures representing the consumption of copper in 1906 and 1907. All the figures in both tables are for refined copper.[a] The first method is based essentially on the total output of domestic refineries.

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[a] It may be pointed out that until recently statistics of consumption have been made on the basis of smelter production and imports and exports of materials, only part of which were in the refined state. In the report corresponding to this for the year 1906, consumption was estimated on the true basis, that of refined copper, and this method is now employed by other statisticians, so that it is to be hoped that uniform and reliable data on consumption in the principal countries will soon be available.

Domestic consumption of refined new copper in 1906 and 1907, in pounds.

[First method.]

	1906.	1907.
Total refinery output	1,079,052,409	1,032,516,247
Refined copper imported	28,191,053	(a)
Stock at beginning of year	72,270,417	46,497,181
Total available supply	1,179,513,879	1,079,013,428
Refined copper exported	446,750,711	465,496,007
Stock at end of year	46,497,181	125,745,796
Total withdrawn from supply	493,247,892	591,241,803
Apparent consumption	686,265,987	487,771,625

[a] Such refined copper as was imported in 1907 was re-refined and is included in total refinery output.

The figures for total available supply arrived at by the second method include the refined copper equivalent of total foreign imports.

Domestic consumption of refined new copper in 1906 and 1907, in pounds.

[Second method.]

	1906.	1907.
Domestic refined new copper produced	887,682,387	784,271,427
Foreign imports in terms refined copper	215,402,841	238,031,320
Stock refined copper at beginning of year	72,270,417	46,497,181
Total available supply	1,175,355,645	1,068,799,928
Refined copper exported	446,750,711	465,496,007
Stock refined copper at end of year	46,497,181	125,745,796
Total withdrawn from supply	493,247,892	591,241,803
Apparent consumption	682,107,753	477,558,125

It will be seen that the apparent consumption in 1907 as computed by the first method is over 10,000,000 pounds greater than the result given by the second method. There is a disparity in the same direction, though smaller, in the figures for 1906. Owing to the fact already pointed out, that the imports for both years are undoubtedly too low, even after an addition has been made for copper recovered from pyrite, the larger quantities, arrived at for the most part independently of the import statistics, are regarded as the more accurate, and the figures chosen as probably best representing the consumption, viz, 485,000,000 in 1907 and 685,000,000 in 1906, are nearest these hgiher values.

The total apparent consumption in the United States of refined copper, both new and reworked, amounted to about 545,000,000 pounds in 1906 and to 735,000,000 pounds in 1907, since practically all the second-hand copper produced in both years—60,000,000 pounds in 1907 and 50,000,000 in 1906—went into consumption.

It must not be overlooked, however, that the actual quantity of copper used in manufactures and the arts in 1907 was somewhat in excess of the apparent total consumption, for it is known that the large stocks held by consumers at the beginning of the year were very much reduced at the end of the year.

USES.

To the principal uses of copper the consumption of refined new copper may be apportioned as shown in the following table. This distribution is based on partial returns from refiners and copper-selling agencies and on estimates furnished by certain of the principal manufacturing consumers.

Uses of new copper in 1906 and 1907.

	1906.		1907.	
	Quantity.	Percentage.	Quantity.	Percentage.
	Pounds.		*Pounds.*	
Electrical purposes, including wire	340,000,000	49.6	220,000,000	45.3
Brass manufacture	210,000,000	30.7	150,000,000	30.9
Rolling mills, sheet copper	35,000,000	5.1	30,000,000	6.2
Miscellaneous uses, principally castings	100,000,000	14.6	85,000,000	17.6
Total consumption	685,000,000	100.0	485,000,000	100.0

It is of course impossible to make an exact separation, even with complete data. Some sheet copper, copper castings, and brass, for example, are used in electrical industries, while not all the copper wire manufactured is used for the transmission of electricity.

Falling off in consumption of new copper in 1907 is noted in all the principal copper-consuming industries, and the reduction is borne about proportionally by each. The financial depression checked the execution of plans for many large projects in which electrical equipment was a more or less important factor, and the consumption for electrical purposes decreased in somewhat greater proportion than for any of the other principal uses. Copper used in brass making amounted to about 30 per cent of the total consumption in both 1906 and 1907. Owing to the lower price of the metal during the last half of the year copper was put to various uses for which its higher price had been prohibitive. This probably accounts for the proportionately greater consumption of sheet copper, castings, etc.

Of the 60,000,000 pounds of reworked copper that was consumed in 1907 about 8,300,000 pounds was electrolytic and about 13,300,000 pounds was casting copper of high grade. This 21,600,000 pounds was employed for wire, sheets, and brass, while about 38,400,000 pounds was put to miscellaneous uses, most of which did not require the purest copper. Allotting the total consumption of refined copper to the principal uses, the result shown in the following table is reached:

Uses of all copper consumed in 1907.

	Quantity.	Percentage.
	Pounds.	
Electrical purposes, including wire	228,000,000	41.8
Brass manufacture	156,000,000	28.6
Rolling mills, sheet copper	34,000,000	6.3
Miscellaneous uses, principally castings and alloys	127,000,000	23.3
Total consumption	545,000,000	100.0

From data regarding exports and stocks of the various grades of copper, the proportions of the total consumption may be estimated as follows:

Grades of copper consumed in 1907.

	Quantity.	Percentage.
	Pounds.	
Electrolytic	352,000,000	64.6
Lake (nonelectrolytic)	136,000,000	25.0
Casting	57,000,000	10.4
Total	545,000,000	100.0

The greater part of the copper used in the electrical industry was electrolytic copper, although some best Lake copper was used. The brass industry consumed both Lake and electrolytic copper, also some casting. Probably more than half of the copper consumed by the rolling mills was electrolytic, Lake copper being used also to a large extent, and a little casting. Among the principal uses of sheet copper are roofing, the manufacture of receptacles for liquids, and the growing employment in modern buildings for fireproofing, structural, and decorative purposes. For castings and miscellaneous uses casting copper was largely used. Lake copper was used in certain castings for structural purposes, and electrolytic copper was employed largely in the manufacture of bronzes and certain other fine alloys. The railroads are undoubtedly the largest consumers of copper castings, some doing their own casting from raw copper and others purchasing the finished castings. The copper used for miscellaneous structural and ornamental purposes amounts in the aggregate to a considerable proportion of the annual consumption.

A good idea of the relative quantities of copper consumed by various industries is afforded by statistics showing the quantity of copper in each of the several forms in which copper is sold. Figures covering practically the entire production of each grade of new copper by the regular copper refineries have been received from all the companies, and are as follows:

Forms in which new copper was cast in 1907, in pounds.

Form.	Electrolytic.	Lake.	Casting.	Total.	Percentage.
Wire bars	527,621,145	15,278,479	4,510,502	547,410,126	52.1
Ingots and ingot bars	142,459,803	115,591,816	17,382,699	275,434,318	26.2
Cakes	75,682,287	40,116,164	8,819,238	124,617,689	11.9
Cathodes	68,375,309			68,375,309	6.5
Miscellaneous and special	27,200,109	[a] 7,049,394	599,601	34,849,104	3.3
Total	841,338,653	178,035,853	31,312,040	1,050,686,546	100.0

[a] Includes some copper "in process."

Wire bars, of course, represent the consumption for wire, and cakes measure the output of the rolling mills. Ingot shapes and cathodes combined represent closely the quantity of copper purchased for brass and other alloys or castings. These proportions, however, do not apply exactly to domestic consumption, since exports of copper were not in these proportions. Most of the cathodes, for example, were for export orders. In spite of the saving of $2 to $3 per ton, which can be made by dispensing with the final melting and casting, very little cathode copper is used in this country for either brass or castings; American founders apparently prefer ingots, claiming that the porous cathodes oxidize too much to give good results.

No successful substitutes for copper as a conductor of electricity have yet been discovered. Copper has the highest electrical conductivity of any of the metals which are sufficiently cheap to be used, and no alloy containing copper has a conductivity as high as that of the pure metal.

PRICES.

The average quoted price of electrolytic copper at New York in 1907 was 20 cents per pound. In 1906, the corresponding price was 19.30 cents. The average monthly prices for both years are given in the following table, and as an indication of the influence of price on the copper trade there are given for comparison the monthly exports of copper. These export figures, which are extracted from records of the Bureau of Statistics, represent refined copper in great part, but there is included in them unrefined blister constituting less than 10 per cent of the entire quantity:

Monthly prices and exports of copper in 1906 and 1907.

Month.	Prices of electrolytic copper, in cents.		Exports of ingots, bars, etc., in pounds.	
	1906.	1907.	1906.	1907.
January	18.38	24.38	31,985,053	33,372,449
February	17.88	24.88	36,092,275	22,296,773
March	18.30	25.00	38,462,661	32,741,600
April	18.38	24.25	33,830,067	29,960,224
May	18.48	24.00	42,321,749	22,471,075
June	18.50	23.18	39,662,582	40,806,711
July	18.25	21.00	40,520,290	30,446,209
August	18.38	18.25	46,789,702	29,695,950
September	19.13	15.50	34,964,157	38,265,026
October	21.20	13.13	39,245,144	61,467,588
November	21.88	13.38	36,738,984	85,147,446
December	22.88	13.06	34,139,354	82,258,350
Averages and totals	19.30	20.00	454,752,018	508,929,401

The prices given are for electrolytic copper cast in the usual marketable shapes. Cathodes usually sell for 0.125 to 0.15 cent per pound less. The prices of the two other principal grades of copper recognized in this country, Lake copper and casting copper, are controlled primarily by that of electrolytic and fluctuate with it. In the early part of the year when demand was great the best brands of Lake copper were sometimes able to secure a premium of as much as 0.5 cent per pound over the current price of electrolytic. On the other hand, when concessions were made in order to effect sales, Lake copper sometimes sold on an equal footing with electrolytic. Likewise, in the early part of the year the price of casting copper averaged only about 0.25 cent less that that of electrolytic, but later in the year casting grades sold distinctly lower, in some cases as much as 1 cent per pound less than electrolytic.

The prices given in the table and referred to elsewhere above have been derived, in the usual manner, from the average of daily figures published in New York and supposed to represent the basis on which transactions for immediate delivery were made. The prices so arrived at are used in most districts as the basis on which the sale of copper by the miner to the smelter is figured, and consequently these prices are used in the reports of the Geological Survey for computing the value of the mine production. In other respects, however, such prices are simply indications of the trend of the copper-selling business, and are by no means an accurate measure of the average receipts per pound for the electrolytic copper sold during the year. This so-called average price is in fact so independent of the actual prices received that it is sometimes misleading even for purposes of comparison for various years. For example, in 1906 the average price on this basis was 0.70 cent per pound lower than in 1907, yet it is certain that the average actual receipts per pound were greater for the copper sold in 1906 than for that sold in 1907.

The affairs of the large copper-selling companies are not deliberately made known to the public. The large copper consumers are equally reticent regarding their transactions. In reality the daily prices published by the metal exchanges and the technical press represent the results of such information as reporters and correspondents are able to gain through inquiry at various sources. With few exceptions the figures so arrived at prove to be higher than those at which actual sales were made. This may be in part due to the fact that the bulk of such information as is ascertained comes from producers and sellers. But even if the daily prices that are published were actual prices at which sales are made, the year's average of such prices would certainly be inaccurate, since the quantity of copper sold daily varies between extremely wide limits.

It is known that about the middle of the year the stock of refined copper held by producers was unusually large, and although this stock was reduced somewhat in the remaining months, the stock of refined copper remaining unsold at the end of the year, as shown on page 66, was about 125,000,000 pounds. From the best available data it appears that the refinery production during the last half of the year was about 78,000,000 pounds less than during the first half. There is every reason to believe, therefore, that more copper was sold at the high prices of the first half of the year than at the lower prices of the last half. Provided the published daily prices were correct, the actual average sales price for the year should therefore be higher than the arithmetical average of such daily prices. But as will be shown such was not the case.

If the quantity sold and the amount paid could be ascertained for every transaction, the true average price for the year could, of course, be derived; but in the case of electrolytic copper there is no means of obtaining these important items for more than a small portion of the total quantity of copper sold. Many of the Michigan companies, however, give this information regarding Lake copper in their annual reports. In the accompanying table the essential figures for the last two years are given for those companies that operated throughout the whole of the years 1906 and 1907 and that have given out the figures for publication:

Sales and prices of Lake copper in 1906 and 1907, by companies.

	1906.		1907.	
	Copper sold.	Price per pound.	Copper sold.	Price per pound.
	Pounds.	*Cents.*	*Pounds.*	*Cents.*
Franklin	[a] 4,368,538	18.59	[b] 2,381,178	19.34
Allouez	3,486,900	19.15	2,934,116	[c] 18.99
Quincy	16,194,838	[c] 19.51	19,796,058	[c] 18.78
Centennial	2,253,015	19.51	2,373,572	[c] 18.46
Tamarack	9,832,644	18.85	[b] 6,931,397	18.38
Mass	[a] 2,106,739	[d] 19.52	2,078,677	18.26
Osceola	18,588,451	18.89	[b] 11,080,210	18.17
Copper Range	40,860,476	19.00	[b] 35,187,549	[c] 18.00
Isle Royale	2,937,098	18.81	[b] 2,354,198	[c] 17.77
Mohawk	9,352,252	19.60	10,107,266	15.66
Michigan	2,875,341	19.77	2,665,404	15.41
Total copper sold	112,856,292		97,889,622	
Average price		19.12		17.97

[a] Does not represent entire output for 1906, but only that portion sold within the year.
[b] Does not represent entire output for 1907, but only that portion sold within the year.
[c] Probably includes proceeds from silver produced.
[d] Does not include proceeds from silver produced.

It will be observed that all these companies, except the Franklin, received a lower price in 1907 than in 1906. In the case of that company, this higher price was secured by selling principally during the earlier months of the year, and by carrying over unsold until 1908 almost all the last six months' production. Other companies besides the Franklin, included in the table above, that remained out of the market during the latter part of the year, and consequently sold in 1907 less than the year's output were the Copper Range, the Osceola, the Tamarack, and the Isle Royale, and the copper of these five companies unsold at the end of the year amounted to 15,733,326 pounds. Three of these five mines, the Osceola, the Tamarack, and the Isle Royale, not only failed to sell in the latter part of the year all that they produced, but also curtailed production considerably. Thus, even though the larger part of the (roughly) 98,000,000 pounds accounted for was sold at the higher prices for the year, the average price per pound of this Lake copper was only 17.97 cents, or more than 2 cents lower than the so-called average price based on daily quotations for electrolytic in 1907, and more than 1 cent lower than the corresponding actual receipts for 1906. By including only those companies of the above list which sold their whole year's output within the year 1907, and therefore probably made fairly regular sales throughout the year, it is found that the average price per pound received by them was 17.74 cents per pound. Although these prices are undoubtedly much more nearly accurate than those based on daily quotations, they are themselves not wholly reliable, because they include factors which in many cases can not be estimated from the data given in the companies' annual reports. As an example: The Osceola annual report for 1906 indicates that the gross value of the copper sold within the year gave the average price of 18.89 cents per pound, while a more recent Osceola statement indicates that the gross value of the copper sold in 1906 corresponds to an average price of 19.72 cents per pound. Further, in the case of five companies in the foregoing list, the gross receipts from sales, from which the average price is computed, appear to include proceeds from both copper and silver, thus giving a higher price than was actually received for the copper alone.

The only conclusion there seems to be is that any average price for copper that may be compiled is at best only a rough approximation, and may be incorrect by several per cent. Considering the large output of the Calumet and Hecla Company, which always sells at a good price, and including the year's figures for the Adventure, the Ahmeek, the Victoria, the Winona, and the Wolverine, most of which have not been given out publicly, the average price received for all Michigan copper sold in 1907 may be estimated at about 18.4 cents per pound.

WORLD'S PRODUCTION.

The smelter production of copper in the world was 1,589,809,300 pounds in 1907; in 1906 the production was 1,596,973,700 pounds, and in 1905 it was about 1,545,137,000 pounds. In 1907 the smelter output of the United States was 54.66 per cent of the world's total production, in 1906 it was 57.47 per cent, and in 1905 it was about 57.52 per cent.

The following table shows the output of the various copper-producing countries in 1906 and 1907. The figures are those compiled by Messrs. Henry R. Merton & Co. (Limited), of London, reduced to pounds, except that the official figures of the United States production, in even hundreds, are inserted:

World's production (smelter output) of copper in 1906 and 1907, in pounds.

	1906.	1907.		1906.	1907.
Algeria	985,600	156,800	Mexico	135,800,000	126,705,600
Argentina	235,200	492,800	Namaqualand	5,824,000	5,600,000
Australasia	81,200,000	92,400,000	Newfoundland	5,140,800	3,875,200
Austria	2,744,000	2,060,800	Norway	13,708,800	16,702,400
Bolivia	5,600,000	5,600,000	Peru	19,051,200	23,688,000
Canada	57,030,400	57,377,600	Russia	23,497,600	33,600,000
Cape Colony	8,825,600	9,475,200	Spain	105,055,200	111,272,000
Chile	57,668,800	59,774,400	Portugal	5,421,600	
England	1,120,000	1,568,000	Sweden	1,120,000	4,480,000
Germany	45,561,600	45,897,600	Turkey	952,000	2,800,000
Hungary	470,400	280,000	United States	917,805,700	868,996,500
Italy	6,417,600	7,392,000			
Japan	95,737,600	109,614,400	Total	1,596,973,700	1,589,809,300

LEAD.

By C. E. Siebenthal.

INTRODUCTION.

An advance statement of the production and consumption of lead as metal in the United States in 1907, as compared with 1906, has already been issued. The present report contains, in addition, the recovery of lead from secondary sources, the production of lead pigments made directly from ore, and an account of the conditions of trade for the year 1907.

The statistics of production in this country are based upon confidential returns to the Survey by all lead smelting and refining companies in operation during the year. The statistics of domestic consumption are taken in part from the smelter returns and in part from the records of the Department of Commerce and Labor, and the tables of foreign production and consumption are compiled from the sources indicated.

The attempt, in the report for 1906, by J. M. Boutwell to distribute the production of the metal more closely according to the source of the ore met with general approval. The only innovations in the present report are the inclusion of statistics from mine operators in the Mississippi Valley, a more systematic attempt to ascertain the recovery of the metals from secondary sources, and the comparison of state totals on the basis of the production of primary lead,[a] both in metal and in pigment.

STATE OF THE LEAD INDUSTRY IN GENERAL.

Although the lead industry suffered from depressed trade conditions in common with the other metal industries, and production was sharply curtailed in the latter portion of 1907, nevertheless the prosperous conditions inherited from 1906 so encouraged activity in the earlier part of 1907 that the figures for the whole year show an increase over those for 1906 even greater in proportion than the increase for 1906 over 1905.

The extreme variation in prices during 1907 is shown by the facts that in the early part of the year the price equaled the high figure for 1906, the highest in twenty-five years, and that the bottom price reached near the close of the year was the lowest in ten years.

In the early part of the year the demand in the United States and lower prices in London encouraged the importation of considerable foreign refined pig lead, which, while only half as much as in 1906, was four times the importation for 1905. On the other hand, the dullness near the close of the year was such that several smelters in Utah, Idaho, and Montana either closed down or ran on reduced shipments. Imports of ore and base bullion fell off slightly from the figures for 1906.

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[a] By primary lead there is meant lead which has been produced directly from ore. This term is used for purposes of distinction from secondary lead, which is obtained by refining skimmings, drosses, old metals, etc., figures for the production of which are given on a later page. Wherever in this report the word "lead" is used without qualification primary lead is to be understood.

PRODUCTION.

The annual production of lead in the United States from domestic ores since 1825 is shown in the following table. The figures for the years 1825–1882, inclusive, in the absence of official records, have been compiled from the best available sources. Totals for 1882 were compiled from statistics gathered by the Census Bureau. Figures for subsequent years are based on returns collected by the Survey.

Production of lead in the United States, 1825–1907, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1825	1,500	1849	23,500	1869	17,500	1889	156,397
1830	8,000	1850	22,000	1870	17,830	1890	143,630
1831	7,500	1851	18,500	1871	20,000	1891	178,554
1832	10,000	1852	15,700	1872	25,880	1892	173,305
1833	11,000	1853	16,800	1873	42,540	1893	163,982
1834	12,000	1854	16,500	1874	52,080	1894	162,686
1835	13,000	1855	15,800	1875	59,640	1895	170,000
1836	15,000	1856	16,000	1876	64,070	1896	188,000
1837	13,500	1857	15,800	1877	81,900	1897	212,000
1838	15,000	1858	15,300	1878	91,060	1898	222,000
1839	17,500	1859	16,400	1879	92,780	1899	210,500
1840	17,000	1860	15,600	1880	97,825	1900	270,824
1841	20,500	1861	14,100	1881	117,085	1901	270,700
1842	24,000	1862	14,200	1882	132,890	1902	270,000
1843	25,000	1863	14,800	1883	143,957	1903	282,000
1844	26,000	1864	15,300	1884	139,897	1904	307,000
1845	30,000	1865	14,700	1885	129,412	1905	302,000
1846	28,000	1866	16,100	1886	130,629	1906	350,153
1847	28,000	1867	15,200	1887	145,700	1907	365,166
1848	25,000	1868	16,400	1888	151,919		

PRODUCTION BY STATES.

The lead content of ores mined and smelted in this country from 1900 to 1905, inclusive, is given below by States from which the ores were derived. The figures were compiled from smelter reports and it should be noted that they represent the content of the ores and not the actual recovery, which is the quantity available for consumption. The latter quantity, termed merchant lead, has regularly been derived from the figures for lead content by allowing 5 per cent loss therefrom for smelting, desilverizing, and refining.

Lead content of ores smelted by the works in the United States, 1900–1905, by States, in short tons.

State or Territory.	1900.	1901.	1902.	1903.	1904.	1905.
Colorado	82,137	73,265	51,833	45,554	51,884	56,638
Idaho	85,444	79,654	84,742	99,590	108,854	99,027
Utah	48,044	49,870	53,914	51,129	56,470	44,996
Montana	....	5,791	4,438	3,303	3,635	2,207
New Mexico	....	1,124	741	613	1,363	1,232
Nevada	....	1,873	1,269	2,237	1,873	2,206
Arizona	....	4,045	599	1,493	1,499	2,091
California	520	381	175	55	163	116
Washington	....	1,029	1,457	538	622	56
Oregon, Alaska, South Dakota, Texas			2,184	1,765	41	101
Missouri, Kansas, Wisconsin, Illinois, Iowa, Virginia, and Kentucky	....	67,172	79,445	86,597	92,275	104,058
Total lead content American ores smelter	....	284,204	280,797	292,874	318,679	312,728
Content Mexican ores	....	11,841	8,755	56,890	24,952	....
Content Canadian ores	....	9,615	2,164	253	11	....
Content miscellaneous or unknown	....	804	3,975	2,831	1,113	....

The closer distribution of the lead production among the States from which the ore was derived, and the fact that the figures represent lead in base bullion produced rather than lead content of ore, have necessitated the separate table which follows, showing the actual recovery of lead, both argentiferous and soft, from all ores derived from the various States and smelted in 1906 and 1907. Deduction has been made for the silver content, but not for the antimony content of the base bullion. Allowance should, therefore, be made in the total for 1,560.5 tons of antimony contained in 9,910 tons segregated as antimonial lead, which it was impossible to trace to its origin. It was also impossible to trace to its origin the lead derived from zinc residues and a small quantity derived from ores.

Metallic lead produced in the United States in 1906 and 1907, apportioned by States according to source of ore, in short tons.

Source of ore.	1906.			1907.		
	Quantity.	Percentage of total.	Rank.	Quantity.	Percentage of total.	Rank.
United States:						
Alaska	8	0.002	17	0	0.6	
Arizona	2,884	.83	5	2,340	.64	7
Arkansas		.12		15	.004	19
California	432	.12	12	854	.23	11
Colorado	50,497	14.51	4	48,876	13.43	4
Georgia				2	.0005	21
Idaho	117,117	33.65	1	112,569	30.94	2
Illinois	572	.16	11	498	.14	12
Iowa	270	.08	13	225	.06	15
Kansas	1,932	.56	7	1,798	.49	10
Kentucky	44	.01	15	75	.02	17
Missouri	111,075	31.91	2	122,856	33.77	1
Montana	2,485	71	6	2,035	.56	8
Nevada	1,669	.48	9	3,380	.93	6
New Mexico	640	.18	10	1,927	.53	9
Oklahoma				404	.11	13
Tennessee	11	.003	16	16	.004	18
Texas				10	.002	20
Utah	56,260	16.16	3	61,699	16.96	3
Virginia				82	.02	16
Washington	46	.015	14	281	.08	14
Wisconsin	1,753	.50	8	3,551	.98	5
Undistributed	[a] 405	.12		355	.10	
Total from domestic ores	348,100	100.00		363,848	100.000	
Zinc residues	2,053			1,318		
Total domestic	350,153			365,166		
Foreign:						
Africa				323	.48	
British Columbia	7,238	12.88		5,793	8.59	
Central America	112	.20		0		
China	18	.03		0		
Mexico	48,839	86.89		60,247	89.36	
South America				911	1.35	
Other foreign				149	.22	
Total from foreign ores	[b] 56,207	100.00		[c] 67,423	100.00	
Grand total, from all sources	406,360			432,589		

[a] Including, according to special reports, 25 tons of lead from Texas.
[b] Exclusive of 12,339 tons lead derived from Mexican bullion.
[c] Exclusive of 9,426 tons of lead from Mexican and other foreign bullion.

Several facts of interest are brought out by the table. Missouri and Idaho change places in rank. The production of the former State shows an increase of nearly 12,000 tons, while the output of Idaho fell off over 5,000 tons. Among the other large producers, Colorado had a slightly smaller output and Utah made a healthy gain. Of the smaller producers Nevada and Wisconsin each doubled in production.

Among the foreign countries contributing ore to domestic smelters, British Columbia fell off slightly and Mexico made a gain of 23 per cent. Africa and South America each contributed small quantities.

REFINED LEAD

The following table of the production of refined lead shows the total quantity of lead refined in the United States from all sources, also the production of desilverized lead and of soft lead, as well as the lead obtained by refining both domestic ores and base bullion and also foreign ores and base bullion. Since the soft lead is all of domestic origin, the quantity of desilverized lead of domestic origin for any year can readily be obtained by substracting the lead of foreign origin from the total desilverized lead production of that year, or by substracting the soft lead from the total domestic lead for that year. The figures for 1906 are exclusive of 10,546 tons of antimonial lead, while about 25,000 tons of desilverized lead from Mississippi Valley ores are included in the production of desilverized lead and excluded from the soft lead figures. In 1907 the figures exclude 9,910 tons of antimonial lead, while 29,659 tons of desilverized Mississippi Valley lead appear in the desilverized lead column, but not in the production of soft lead.

The production of refined lead shows an increase of 2.1 per cent over the total for 1906.

Production of refined lead in the United States, 1883–1907, in short tons.

Year.	Desilverized lead.[a]	Soft lead.[b]	Total production.[a]	From domestic ores and base bullion.	From foreign ores and base bullion.
1883	122,157	21,800	143,957	143,957	....
1884	119,965	19,932	139,897	139,897	....
1885	107,437	21,975	129,412	129,412	....
1886	114,829	20,800	135,629	130,629	[c] 5,000
1887	135,552	25,148	160,700	145,700	[c] 15,000
1888	151,465	29,090	180,555	151,919	28,636
1889	153,709	29,258	182,967	156,397	26,570
1890	130,403	31,351	161,754	143,630	18,124
1891	171,009	31,397	202,406	178,554	23,852
1892	181,584	31,678	213,262	173,305	39,957
1893	196,820	32,513	229,333	163,982	65,351
1894	181,404	37,686	219,090	159,351	59,739
1895	201,992	39,890	241,882	165,709	76,173
1896	221,457	43,537	264,994	187,256	77,738
1897	247,483	43,553	291,036	207,365	83,671
1898	267,842	42,779	310,621	210,676	99,945
1899	263,826	40,566	304,392	208,466	95,926
1900	329,658	48,021	377,679	270,824	106,855
1901	323,790	57,898	381,688	269,266	112,422
1902	303,011	74,050	377,061	276,455	100,606
1903	295,074	83,444	378,518	290,194	88,324
1904	315,284	89,169	404,453	308,603	95,850
1905	296,186	103,116	399,302	318,509	80,793
1906	313,886	90,860	404,746	338,347	66,399
1907	314,241	99,948	414,189	337,340	76,849

[a] Including foreign base bullion refined in bond.
[b] Including a small quantity of lead produced in the Southern States.
[c] Estimated.

SOFT LEAD.

The quantity of soft lead recovered in 1907, apportioned according to the source of the ore, as compiled from direct returns by smelters to the Survey, is shown in the following table. In these totals the 29,659 tons of soft lead which was desilverized is included. The total production shows an increase of 12 per cent over that of the preceding year.

Production of soft lead in the United States in 1907, by States, in short tons.

Rank.	Source of ore.	Quantity.	Percentage of total soft lead.	Rank.	Source of ore.	Quantity.	Percentage of total soft lead.
11	Arkansas	15	0.01	10	Tennessee	16	0.01
4	Illinois	498	.39	8	Virginia	82	.06
6	Iowa	225	.17	7	Washington	87	.07
3	Kansas	1,798	1.39	2	Wisconsin	3,551	2.74
9	Kentucky	75	.06				
1	Missouri	122,856	94.79		Total	129,607	100.00
5	Oklahoma	404	.31				

ANTIMONIAL LEAD.

The production of antimonial lead from ores derived from all sources, as reported direct to this office by all desilverizers operating in this country, is shown in the following table:

Production of antimonial lead in the United States from 1896 to 1907, in short tons.

1896	7,507	1902	9,169
1897	8,867	1903	9,579
1898	8,473	1904	11,001
1899	6,345	1905	10,995
1900	9,906	1906	10,546
1901	10,656	1907	9,910

For 1907 the average antimony content of antimonial lead was 15.7 per cent. On this basis the antimonial lead production for the year contained 1,560.5 tons of antimony and 8,349.5 tons of lead.

PRODUCTION OF LEAD PIGMENTS.

In addition to the leaded zinc oxide and zinc-lead oxide pigments which are noted more particularly in connection with the production of zinc pigments, there are three pigments which are produced directly from lead ore, namely, sublimed white lead, sublimed blue lead, and sometimes litharge. Sublimed white lead consists of lead sulphate 75 per cent, lead oxide 20 per cent, and zinc oxide 5 per cent. Sublimed blue lead consists of lead sulphate 50–53 per cent, lead oxide 38–41 per cent, with small proportions of lead sulphide, lead sulphite, and zinc oxide. Litharge, lead monoxide, is generally manufactured from pig lead, but the quantity given below was made directly from ore. The production of leaded zinc oxide and zinc-lead oxide is repeated here for convenience.

Production of lead pigments in 1907, in short tons.

Sublimed white lead	8,700
Sublimed blue lead	1,211
Litharge	1,214
Leaded zinc oxide Zinc-lead oxide,	13,516
Lead content of these pigments	7,099

PRODUCTION OF SECONDARY LEAD.

Important sources of lead are skimmings, drosses, old metal, and alloys, as babbitt, solder, and type metal. The recovery of lead by refining these materials constitutes an integral portion of the lead industry. This business is mostly carried on at small refineries scattered over the United States, but the large smelters and refineries working primary lead frequently find it advantageous to incorporate material from secondary sources. In such cases it has been noted on the reports of the smelters to the Survey, and to that extent the production of secondary lead has been heretofore taken into account. In the preparation of the present report the attempt was made to reach as many as possible of the refiners working on secondary material. It is not to be supposed that the effort was completely successful, but returns from 44 of the more important refineries of secondary lead are embodied in the table below. The product of such refineries is of two classes, pig lead and lead in alloys. In the latter case the lead may have been recovered in the form of pig lead and alloyed at the refinery or it may have been refined as an alloy, being brought up to the desired composition by addition of the proper metal.

Production of secondary lead in the United States in 1907, in short tons.

Pig lead	9,990
Lead in alloys	15,508
Total recovered lead	25,498

COMPARISON OF STATE TOTALS BASED ON SMELTER RETURNS AND ON MINE REPORTS.

The foregoing figures of the production of metallic lead by the respective States are compiled from reports of individual lead smelters and refineries. For several years the production of the more valuable metals in the Western States has been obtained by the Survey from reports of individual mines. In 1906 the same method was followed in the Atlantic States, and in 1907 the plan was extended to take in the whole country. In order to put the smelter production on the same basis as the mine figures, all the lead which was produced as pigments directly from ore is added to the production of metallic lead. The lead recovered from secondary sources is excluded from these totals since it has already been reckoned once as pig lead. These facts must be borne in mind in comparing this table with the preceding tables. The State totals obtained by each method are compared in the following table.

Comparison of State totals compiled from smelter and mine returns, in short tons.

State or Territory.	Totals based on smelter reports.	Totals based on mine reports.	Differences.	
			Smelter excess.	Mine excess.
Arizona	2,350	2,330	20	
Arkansas	15	12	3	
California	854	1,313		459
Colorado	50,596	42,703	7,893	
Idaho	112,569	116,912		4,343
Illinois	509	830		279
Iowa	225	242		17
Kansas	1,929	2,555		626
Kentucky	75	34	41	
Missouri	127,373	138,675		11,302
Montana	2,035	1,874	161	
Nevada	3,380	3,136	244	
New Mexico	2,126	1,905	221	
Oklahoma	476	532		56
Tennessee	16	0	16	
Texas	10	12		2
Utah	62,073	57,969	4,104	
Virginia	[a] 84	[a] 70	12	
Washington	346	410		64
Wisconsin	3,551	3,499	52	
Total	370,592	375,013		

[a] Includes also production of Georgia and New Hampshire.

The smelter totals represent actual recovery and are found by summing up the total production reported by all companies for each State, respectively, and recalculating all pigments back to equivalent metallic lead on the basis of average analysis of product. In compiling the mine totals each producing property is requested to report actual tonnage of lead ores and concentrates shipped, and from this tonnage the lead content is reckoned by assay value. The quantities thus obtained from all the producing properties in each State are combined to afford the total for the respective States. It is clear that by either method the correctness of the totals is dependent upon complete and correct returns from every producing mine and smelter. It is further essential to the correctness of the mine totals that the assay content be correctly estimated.

Theoretically, the State totals as compiled from smelter reports and from mine reports, respectively, should agree. Practically, however, they frequently differ considerably. The causes of this difference fall into four categories. The first is lag, by which is meant the time that elapses between the shipment of ore by the mine and the reduction of the ore by the smelter. This is frequently considerable, for ore raised near the end of the year may remain in the stock bins of the smelter or of the refinery until the succeeding year, thus leading to an apparent "mine excess." If through accident, business depression, or otherwise the mines close down, the smelters largely consume their ore stocks, which results in an apparent "smelter excess." The second source of difference is found in error in the mine totals, either in ore tonnage or in the arbitrary calculation of metal content from assay. The dry assay in vogue in the Western States gives results uniformly too low. A third source is found in failure of the smelter returns to segregate accurately the ore from the different States.

Until 1906 the ore coming from the Joplin district was lumped by the smelters as from Missouri or Missouri-Kansas, though some of it was from Oklahoma. This made a smelter excess for Missouri and a mine excess for Kansas and Oklahoma. The same custom was to a certain extent true of the upper Mississippi Valley district. Though apportioned to the proper States in 1906 and 1907, the division is confessedly a rough estimate in the case of some of the smelters which do not keep the ore from these regions separate on their books. Lastly, there is not taken into account in these totals the loss in smelting, ranging from 2 per cent in the case of the better ordered smelters to 5 per cent or more in the smaller soft-lead smelters. Lag being left out of account, each State would normally show a small mine excess equal to this smelting loss. Any discrepancy which appears in the table may reasonably be ascribed to one or more of these items. In the long run, barring error and allowing for smelting losses and exportation of ore, the "mine excess" will be balanced by equivalent "smelter excess."

SMELTER AND MINE TOTALS.

In most cases the totals agree closely, but in a few cases it may be well to point out the probable cause of the disparity. In California the mine excess was clearly due to lag, the production showing a considerable increase, a portion of which had not yet been smelted at the close of the year. The smelter excess in Colorado was much larger than the mine excess in 1906, and, barring error, must have been due to depletion of stocks of Colorado ores in the smelters and of Colorado bullion in the refineries. The mine excess in Idaho was considerably reduced from that of 1906, being for 1907 not quite 4 per cent of the smelter total; it was no doubt due in large part to smelting losses. The mine excess in Illinois and Kansas was apparently due to the fact that some ore from those States had been credited by the smelters to Wisconsin and Missouri, respectively. The mine excess in Missouri may have been due to one or all of three things—to lag, to too high assay estimate of lead content of mine reports, or to comparatively large smelting losses. The excess amounted to about 8 per cent of the mine production. It has been pointed out that the smelting losses are sometimes above 5 per cent. As a matter of fact, however, the Missouri ores are easy of reduction, and most of the furnaces running on them are of modern type, so that the average smelting loss must be well under 5 per cent. The smelter excesses in Montana, Nevada, and New Mexico seem a natural result of the diminished output of the mines in the latter part of the year, resulting in depletion of the smelter ore stocks from those States. The large smelter excess in Utah is plausibly explained the same way, the more so as there was a large mine excess in 1906, due partly to smelting losses, but mostly to lag, and the smelters must have started the year 1907 with large stocks of Utah ore.

REDUCTION.

ADVANCE IN METHODS AND CAPACITY.

Progress in concentration during the year has been mainly limited to improvements in machinery handling both lead and lead-zinc ores, and is discussed in the report on zinc.

In the metallurgy of lead the advance has been largely made in replacing old machinery by more modern forms having greater economy of operation and greater capacity. No radical changes in process were developed during the year. The agitation against smelter fumes in various localities has resulted in various plans and devices for smoke consumption.

The new electrolytic refinery of the United States Smelting, Refining, and Mining Company at Grasselli, Ind., was in operation practically the full year. The new smelter of the Keller and Indiana Consolidated Smelting Company, at Keller, Wash., was not started up, on account of the adverse industrial situation. Construction was begun on the independent Knight smelter at Tintic, Utah, which, when completed, will have a capacity of 400 tons, ultimately to be increased to 800 tons. The smelter of the Panhandle Smelting Company (Limited), at Ponderay, Idaho, was completed about the middle of the year and ran several months, but closed down during the depression at the close of the year. The new 100-ton smelter of the Northern Smelting Company, at Waukesha, Wis., started up in 1907 and was in operation four months during the year. It treats ore principally from the upper Mississippi Valley district.

RESOURCES.

It has been customary in these reports to give a summary of mining developments during the year in each of the main lead-producing States, together with an outline description of the main producing districts or properties. In 1907 for the first time the mine reports, to be found in another part of the volume, covered every State which produced either gold, silver, copper, lead, or zinc. In those reports, under each State, will be found a much more complete review than it would be expedient to give at this place.

A source of lead, the importance of which justifies a word in this connection, is one which is generally overlooked in considering the resources of the country, namely, lead recovered from secondary materials. The supply of such lead during 1907 was 25,498 short tons, an amount exceeded by the lead production of but four States.

TRADE CONDITIONS.

WORLD'S PRODUCTION OF LEAD.

The following table of the production of lead in the world has been calculated from the statistics published by the Metallgesellschaft and Metallurgische Gesellschaft A.-G., of Frankfurt-am-Main, Germany with the substitution of the figures collected by the Geological Survey for the production of the United States. It should be noted that the small but important production of South America is not included. In 1907, as shown on a preceding page, there was produced in the United States from South American ores 911 short tons of lead. The ore from which this was derived must have been imported in part during 1906, since the total imports of lead in ore and base bullion in 1907 amounted to but 492 short tons.

The world's production of lead, 1904–1907, in short tons.

Country.	1904.	1905.	1906.	1907.
Australia	131,615	117,946	102,514	106,923
Austria-Hungary	14,440	14,881	18,078	16,975
Belgium	25,904	25,243	24,471	28,417
Canada	18,960	28,329	26,235	23,778
France	20,723	26,565	28,219	25,353
Germany	151,676	168,211	166,117	157,156
Great Britian	26,896	25,684	26,455	30,203
Greece	16,755	15,102	13,338	15,212
Italy	25,904	21,054	23,479	25,243
Japan	1,984	2,535	3,858	3,858
Mexico	92,483	82,673	59,524	79,366
Russia	331	331	331	110
Spain	195,989	199,186	199,406	204,848
Sweden	661	661	882	772
Turkey in Asia	11,795	11,464	10,582	11,464
Other countries	331	220	220	220
United States	307,000	302,000	350,153	365,166
Total	1,043,447	1,042,085	1,053,862	1,095,064
United States percentage of world's production	29.5	29.0	33.2	33.3

IMPORTS AND EXPORTS.

In recent years the production of lead in the world and also in the United States has steadily increased. The consumption of lead in the world and also in this country has likewise increased, though the latter is gaining faster in production than it is in consumption, as is evidenced by the material reduction in the imports of lead as shown in the following table, according to the records of the Bureau of Statistics of the Department of Commerce and Labor.

Lead imported and entered for consumption in the United States, 1900–1907, in pounds.

Year.	Ore and dross.		Pigs and bars.		Sheets, pipe, and shot.		Not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
1900	10,209,742	$623,802	3,673,616	$76,141	27,945	$1,393	$877	$702,213
1901	10,324,119	272,396	3,604,157	88,056	56,735	2,773	1,234	364,459
1902	14,499,339	316,005	12,443,615	319,035	224,209	7,765	5,258	648,063
1903	41,155,130	716,128	8,972,635	255,135	17,008	810	1,589	973,662
1904	19,015,540	328,279	17,334,033	480,823	69,581	2,441	5,277	816,820
1905	49,526,990	784,548	10,379,753	329,209	77,668	3,813	1,139	1,118,709
1906	[a]44,560,258	[a]755,545	24,882,983	960,998	346,177	17,250	4,503	[a]1,738,296
1907	[b]12,893,875	[b]286,802	15,666,615	718,179	734,418	39,210	3,450	[b]1,047,641

[a] Exclusive of 587,731 pounds of base bullion, valued at $15,635.
[b] Exclusive of 1,196,224 pounds of base bullion, valued at $35,303.

Imports of lead, refined, in ore, and in base bullion; sources and quantities, 1902–1907, in pounds.

Country.	1902.	1903.	1904.	1905.	1906.	1907.
United Kingdom	792,607	1,552,772	494,556	1,589,859	9,852,760	433,971
Germany	952,878	1,409,926	731,222	250,241	2,006,369	456,649
Other European countries	1,342,193	451,331	165,661	117,699	3,920,313	6,922,276
Total from Europe	3,087,678	3,414,029	1,391,439	1,957,799	15,779,442	7,812,896
British North America	19,464,937	19,200,806	17,903,798	16,362,916	18,514,244	13,272,900
Mexico	187,484,666	186,136,779	205,805,911	175,167,694	133,512,526	137,543,692
South America	5,380,306	3,895,536	579,918	3,154,483	315,265	883,355
Other countries	12,163	166,336	22,246	112,516	147,462	116,868
Total imports	215,429,750	212,813,486	225,703,312	196,755,408	168,268,939	159,629,711

In the foregoing table, 98 per cent of the imports of lead from Europe in 1907 were in the form of refined lead, while 90 per cent of the imports from all other countries consisted of ore and base bullion.

Lead, and manufactures of lead, of domestic production, exported, 1900–1907, in pounds.

Year.	Manufactures of lead.		Pigs, bars, and old.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1900	[a] 363,600	[b] $130,758 [c] 240,149	1,993,773	$88,664	$459,571
1901	[a] 490,460	[b] 178,752 [c] 230,940	4,787,107	214,842	624,534
1902	[a] 454,423	[b] 153,309 [c] 256,153	6,542,760	286,548	696,010
1903	[a] 364,220	[b] 127,530 [c] 357,622	112,544	6,210	491,362
1904	[a] 439,953	[b] 160,863 [c] 451,785	70,408	3,478	616,126
1905	[a] 445,002	[b] 156,162 [c] 506,076	125,332	5,623	667,861
1906	[a] 505,750	[b] 175,719 [c] 590,992	147,551	9,065	775,776
1907	[a] 729,695	[b] 269,982 [c] 679,000	110,104	7,096	956,078

[a] Type. [b] Value of type. [c] Value of all other manufactures.

LEAD DRAWBACK.

A bill modifying the regulations concerning the smelting of lead ore in bond, and increasing the drawback from 90 to 99 per cent of the import duties, was introduced at the last session in both Houses of Congress and referred to the appropriate committees.

CONSUMPTION.

In previous statements of lead consumption in these reports it has been the custom to take into account the smelter stocks of lead at the beginning and at the close of the year. It is not to be denied that for the individual year this gives closer figures. However, it is just as true that account of trade stocks should also be taken to arrive at accurate results; but this is manifestly outside the scope of this office. Moreover, in a year such as 1907, when smelter stocks were largely increased, the prompt publication of authentic figures of such stocks would have a speculative interest to the stock market which it is highly desirable should not accrue to a government statistical annual. Producers with large accumulations of stock are naturally averse to giving out such figures even for publication as totals. In 1907 complete figures for stocks on hand at close of year were not obtainable, and the result of the calculation for consumption has therefore been expressed as "lead available for consumption." For facility of comparison of consumption in the United States with that of the world, the consumption of the former has been calculated with and without stocks for a period of ten years, as shown in the following table. Consumption of lead, as shown in the second column, means the production of refined lead plus excess of exports over imports or minus excess of imports over exports. Additions made to stock during the year will thus appear as consumed, but as such stocks are apt to go into the market within the next year and cut down the apparent consumption to that extent, they thus compensate in the long run, leaving an accurate average measure of the consumption. The statistics of consumption of foreign countries as given in the table are taken from the estimates of the Metallgesellschaft and the Metallurgische Gesellschaft A-G, which are also compiled without regard to stocks. In the following table, the first column gives, for the sake of comparison, the consumption with stocks taken into consideration; the remainder of the table disregards stocks. In neither column showing the United States consumption is the production of secondary lead taken into account. This, so far as known, amounted to 9,990 tons in the form of pig lead, and 15,508 tons of lead recovered in the form of alloys. Inasmuch as this, for the purposes for which it was used, took the place of so much primary lead, there should be added to the figure of consumption in 1907, as representing the consumption of secondary lead, 25,498 tons.

World's consumption of pig lead exclusive of secondary lead, 1898–1907, in short tons

Year.	United States.		In foreign countries, stocks disregarded.	Total world's consumption, stocks disregarded.	United States percentage of total.
	Stocks considered.	Stocks disregarded.			
1898	227,452	225,177	651,018	876,195	25.70
1899	226,315	230,294	652,782	883,076	26.08
1900	269,302	279,172	667,002	946,174	29.50
1901	271,934	284,126	663,805	947,931	29.97
1902	332,484	300,643	685,079	985,722	30.50
1903	300,167	284,556	701,945	986,501	28.85
1904	319,543	320,330	719,471	1,039,801	30.81
1905	347,015	343,682	736,998	1,080,680	31.80
1906	376,337	376,981	703,378	1,080,359	34.89
1907	[a] 390,939	386,351	697,205	1,083,556	35.66

[a] See table consumption of lead in the United States in 1906–7.

Consumption of lead, stocks and secondary lead disregarded, in 1906–7, by countries, in short tons.

Country.	1906.	1907.	Country.	1906.	1907.
Australia	4,960	5,952	Japan	15,983	15,983
Austria-Hungary	26,235	27,778	Russia	27,558	27,668
Belgium	25,022	34,723	Switzerland	5,842	5,842
Canada	17,416	15,983	Other European countries	3,307	3,417
France	94,688	89,397	Other countries	14,661	11,023
Germany	214,838	206,130	United States	376,981	386,351
Great Britain	213,956	214,287			
Holland	5,512	5,732	Total	1,080,359	1,083,556
Italy	33,400	33,290			

The following table has already been given out in the advance sheet of lead production for 1907, but it is here reproduced with the addition of the figures of secondary lead production. Stocks, both domestic and foreign, and production are in terms of refined lead; imports and exports are in finished state; antimonial lead is in marketable form; lead in ores and bullion is excluded. The figures for refined and antimonial lead and for domestic stocks (except as noted) are based upon direct returns from all known operating refineries and from all known smelters producing pig lead from the soft lead ores of the Mississippi Valley. All other figures are from statistics compiled by the Bureau of Statistics of the Department of Commerce and Labor.

Consumption of lead in the United States in 1906–7, in short tons.

	1906.	1907.
Supply:		
Stock beginning of year—		
Domestic	3,975	4,571
Foreign	56	64
Total production—		
Refined lead	404,669	414,189
Antimonial lead	10,546	9,910
Imports, foreign, refined	11,763	9,277
Total available supply	431,086	438,011
Withdrawn:		
Stock close of year—		
Domestic	4,571	(*a*)
Foreign in bond	64	47
Refined in bond from foreign base bullion and ores and exported	48,558	45,782
Lead in manufactures exported under drawback	1,516	[b] 1,243
Total withdrawn	54,709	47,072
Apparent consumption of lead	376,377	
Primary lead available for consumption in the United States		390,939
Total production secondary lead		25,498
Total available lead		416,437

[a] Unknown owing to refusal of one company to furnish information under this head. Undoubtedly much larger than in 1906.

[b] Not including a small unknown amount in miscellaneous manufactures.

MARKET AND PRICES.

The year opened with large stocks in the hands of consumers, particularly in the electrical and plumbing trades, which, according to the Oil, Paint, and Drug Reporter, are responsible for two-thirds of the consumption. With the first premonitory indications of the depression the trades began to use up their stocks, and, prices remaining stationary for some time with light demand, large stocks accumulated at the smelters.

At the beginning of the year pig lead sold at 6 cents per pound for common grades and 6.10 cents for corroding lead. Prices held up until June, reaching a top figure in the open market of 6.35 cents, the highest in thirty years; but from June they sagged gradually until November 18, when, with lead at 4.40 cents per pound, the American Smelting and Refining Company withdrew its support from the market, which rapidly declined until December 16, when lead reached 3.50 cents per pound, the low-water mark of the year and the lowest selling price in ten years. The year closed with lead selling at 3.75 cents. In London soft Spanish lead sold during the year from £22 5s. per long ton (4.83 cents per pound) down to £13 per ton (2.82 cents per pound), closing at £14 5d. per ton (3.09 cents per pound.

In the following table are shown the highest and the lowest prices of lead at New York in each month during the last seven years. All figures for prices are for cents per pound. Those for 1906 and 1907 are based upon daily quotations published in the Engineering and

Mining Journal and those for preceding years on quotations published in the Iron Age.

Highest and lowest prices of lead at New York City, monthly, 1901–1907, in cents per pound.

Year.	January.		February.		March.		April.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1901	4. 37½	4. 37½	4. 37½	4. 37½	4. 37½	4. 37½	4. 37½	4. 37½
1902	4. 10	4. 00	4. 10	4. 05	4. 10	4. 05	4. 10	4. 05
1903	4. 10	4. 05	4. 10	4. 05	4. 65	4. 10	4. 65	4. 35
1904	4. 50	4. 25	4. 50	4. 40	4. 60	4. 50	4. 60	4. 50
1905	4. 60	4. 45	4. 50	4. 45	4. 50	4. 45	4. 55	4. 50
1906	5. 60	5. 60	5. 60	5. 35	5. 35	5. 35	5. 50	5. 35
1907	6. 00	6. 00	6. 00	6. 00	6. 00	6. 00	6. 00	6. 00

	May.		June.		July.		August.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1901	4. 37½	4. 37½	4. 37½	4. 37½	4. 37½	4. 37½	4. 37½	4. 37½
1902	4. 10	4. 05	4. 10	4. 05	4. 10	4. 05	4. 10	4. 05
1903	4. 35	4. 30	4. 35	4. 10	4. 10	4. 05	4. 10	4. 05
1904	4. 50	4. 25	4. 35	4. 20	4. 30	4. 10	4. 20	4. 10
1905	4. 55	4. 50	4. 55	4. 50	4. 60	4. 50	4. 85	4. 60
1906	5. 75	5. 50	5. 75	5. 75	5. 75	5. 75	5. 75	5. 75
1907	6. 00	6. 00	6. 00	5. 75	5. 75	5. 25	5. 25	5. 25

Year.	September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1901	4. 37½	4. 37½	4. 37½	4. 37½	4. 37½	4. 37½	4. 37½	4. 00
1902	4. 10	4. 05	4. 10	4. 05	4. 10	4. 05	4. 10	4. 05
1903	4. 40	4. 10	4. 40	4. 35	4. 40	4. 10	4. 25	4. 10
1904	4. 25	4. 20	4. 30	4. 20	4. 50	4. 20	4. 65	4. 60
1905	4. 90	4. 85	5. 30	4. 85	5. 40	5. 15	5. 90	5. 25
1906	5. 75	5. 75	5. 75	5. 75	5. 75	5. 75	6. 00	5. 75
1907	5. 25	4. 75	4. 75	4. 75	4. 75	4. 00	4. 10	3. 35

SUMMARY.

The following tabular statement gives the general items regarding domestic and world production and consumption. The figures for domestic items are those compiled by this office, and the figures for the world items are based upon statistics compiled by the Metallgesellschaft and the Metallurgische Gesellschaft, A.-G.:

Summary of lead statistics, in short tons.

Production of refined lead in the United States	414, 189
Production of desilvered lead in the United States	314, 241
Production of soft lead in the United States	129, 607
Production of antimonial lead in the United States	9, 910
Total production of lead in the United States from domestic ores	365, 166
Production of secondary lead in the United States	25, 498
Excess of exports of refined lead over imports	37, 748
Consumption of lead in the United States (disregarding stocks)	386, 351
World production (approximate)	1, 095, 064
World consumption (approximate)	1, 083, 556
United States percentage of world production	33. 3
United States percentage of world consumption	35. 6
World rank of United States in production of lead	First.
World rank of United States in consumption of lead	First.

ZINC.

By C. E. Siebenthal.

INTRODUCTION.

An advance statement of the production and consumption of zinc in the form of spelter in the United States in 1907 as compared with 1906 has already been issued. The present report contains, in addition, the production of various zinc pigments, the recovery of metallic zinc from secondary sources, and a résumé of metallurgical advance and of trade conditions for the year.

The statistics of production in this country are based upon confidential returns to the Survey by each zinc-smelting company in operation during the year. The statistics of domestic consumption are taken in part from these smelter returns and in part from the records of the Bureau of Statistics of the Department of Commerce and Labor, while the tables for foreign production and consumption are compiled from the sources indicated.

This report, in form and substance, is necessarily modeled closely after its predecessors, in particular after the report for 1906. The attempt in that report to distribute the production of the metals more closely according to the source of ore met with general approval. The only innovations in the present report are the inclusion of statistics from mine operators in the Mississippi Valley, a more systematic attempt to ascertain the recovery of the metals from secondary sources, and the comparison of mine and smelter state totals on the basis of the whole production of zinc, both metal and pigment.

STATE OF ZINC INDUSTRY IN 1907.

The extreme activity of the first half of the year 1907 more than compensated for the dullness of the last half, so that the production of spelter for the whole year exceeded the ratio of increase established by 1906. Some new smelters, in course of erection in 1906, were completed in 1907, but several old style coal-fired furnaces, which it had been contemplated to fire up, remained in idleness on account of the depression. In the zinc-mining industry, for the same reason, several large propositions of unwatering and reopening old workings and some proposed mergers of individual companies were allowed to lapse.

In the Upper Mississippi Valley district there was much activity, both in mining and in prospecting; in the western Kentucky district the industry was at a standstill; and in the north Arkansas district prospecting was actively carried on and there was an average production. In the Joplin district the low price of ore during the latter part of the year enforced the closing of many of the mines, particularly of the Oronogo-Duenweg sheet-ground belt. In the Eastern States, as noted elsewhere, the promise of the earlier part of the year was not fulfilled, but there was an average production at the usual localities. In the Western States declines were general.

The United States in 1907 became the dominant factor in the zinc industry, leading all other countries in production as well as in consumption, and exceeding the spelter production of the German Empire for the first time.

PRODUCTION.

The production of primary spelter[a] (crude metallic zinc derived from ore) in the United States in 1907 was 249,860 short tons. This production, which includes 26,115 tons of spelter obtained from the smelting of foreign ores, shows an increase of 25,090 tons, or 11.2 per cent over 1906, and is the largest production in the history of the industry. The exact annual progress is indicated in the following table:

Annual production of spelter in the United States, 1873–1907, in short tons.

1873	7,343	1894	75,328
1875	15,833	1895	89,686
1880	23,239	1896	81,499
1882	33,765	1897	99,980
1883	36,872	1898	115,399
1884	38,544	1899	129,051
1885	40,688	1900	123,886
1886	42,641	1901	140,822
1887	50,340	1902	156,927
1888	55,903	1903	159,219
1889	58,860	1904	186,702
1890	63,683	1905	203,849
1891	80,873	1906	224,770
1892	87,260	1907	249.860
1893	78,832		

PRODUCTION BY STATES.

In accordance with the plan adopted for 1906, two tabulations of the spelter production of the country in 1907 are given herein, one showing the locality from which the ores were derived, the other the locality in which they were smelted. Each method has its special interests and advantages, depending on whether the view point be that of producer or consumer, or that of resources. Moreover, the exclusive use of either method does an injustice to some branch of the industry and to some part of the country.

These state totals are compiled entirely from confidential reports by each zinc-smelting company in operation in the United States in 1907. Only primary spelter is here included, the recovery of secondary spelter being given in a later table.

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[a] In mineral Resources for 1906, page 461, zinc derived from ore was called "primary spelter" to distinguish it from the secondary spelter recovered from such sources as drosses, skimmings, and old metal. The former has also been called "virgin" spelter and the latter has been called "remelted spelter." The distinctive origin is more plainly suggested by the terms "primary spelter" and "secondary spelter" and they will be used hereinafter. Where the word "spelter" is used without qualification "primary spelter" will be understood.

The following table shows the sources of all ores and concentrates smelted for zinc in the United States in 1907 and the quantity of zinc actually derived from the ores from these respective sources:

Production of spelter in the United States in 1906–7, apportioned according to source of ore, in short tons.

Source.	1906.			1907.		
	Quantity.	Percentage of total.	Rank of State.	Quantity.	Percentage of total.	Rank of State.
Arizona	64	0.032	17	77	0.03	18
Arkansas	1,801	.90	7	1,911	.85	8
California	....	....	....	140	.06	16
Colorado	32,456	16.25	2	26,077	11.66	2
Idaho	573	.29	11	3,508	1.57	6
Illinois	282	.14	14	1,446	.65	10
Iowa	201	.10	15	220	.10	14
Kansas	3,902	1.96	5	13,850	6.19	4
Kentucky	335	.17	13	358	.16	13
Maine	....	....	....	1	.0004	20
Missouri	130,348	65.27	1	141,824	63.39	1
Montana	1,415	.71	9	0	....	....
Nevada	1,768	.88	8	1,692	.76	9
New Jersey	11,206	5.61	3	13,573	6.07	5
New Mexico	555	.28	12	136	.06	17
Oklahoma	....	....	....	719	.32	12
Tennessee	124	.06	16	181	.08	15
Texas	8	.004	18	16	.0007	19
Utah	2,449	1.23	6	1,972	.88	7
Virginia	1,143	.57	10	771	.34	11
Washington	7	.004	19	0	....	....
Wisconsin	11,057	5.54	4	15,273	6.83	3
Total from United States ores	199,694	100.00	....	223,745	100.00	....
Foreign:						
British Columbia	201	.80	....	545	2.09	....
Mexico	24,875	99.20	....	25,570	97.91	....
Total from foreign ores	25,076	100.00	....	26,115	100.00	....
Grand total	244,770	....	....	249,860	....	....

The subjoined table is designed to show the localities in which spelter was made.

Production of spelter in the United States, 1902–1907, apportioned according to locality in which smelted, in short tons.

	1902.	1903.	1904.	1905.	1906.	1907.
Colorado	....	877	4,871	6,599	6,260	5,303
Eastern and Southern States	12,180	12,301	[a] 14,893	[a] 24,513	29,930	37,626
Illinois	[b] 47,096	[b] 47,659	47,740	46,606	47,939	56,056
Kansas	86,564	88,388	107,048	114.287	129,564	134,108
Missouri	11,087	9,994	12,150	11,844	11,077	11,732
Oklahoma	....	....	....	....	....	5,035
Total	[c] 156,927	[d] 159,219	[e] 186,702	203,849	[f] 224,770	249,860

[a] Including West Virginia.

[b] Including Indiana.

[c] Including 2,675 short tons dross spelter.

[d] Including 3,302 snort tons dross spelter.

[e] Including 3,300 short tons dross spelter.

[f] Primary spelter derived direct from ores and exclusive of 1,500 tons of dross spelter.

ZINC PIGMENTS.

There are four white pigments which have zinc for a base, either in whole or in part, namely, zinc oxide, leaded zinc oxide, zinc-lead oxide, and lithophone. All of these may be, and the first three usually are, made directly from ore.

Zinc oxide is the most important of these pigments. In European practice the oxide is made from spelter, but in this country it is generally made directly from the ores, though in 1907 of the whole production 3,805 tons was made from spelter. The production of zinc oxide in the United States fell off slightly in 1907, being 71,784 short tons, as compared with 74,680 short tons in 1906, a decrease of 2,896 tons, very closely corresponding to the imports of zinc oxide, which amounted in 1907 to 2,837 tons. The exports of zinc oxide for the same period were 13,257 tons.

Leaded zinc oxide and zinc-lead oxide are produced from ore, both, in some cases, at the same plant, the zinc-lead containing somewhat the larger percentage of lead. The combined production of these two pigments in 1907 was 13,516 tons as compared with 8,124 in 1906. This increase was a result of the completion of the plant of the Ozark Smelting and Mining Company, at Coffeyville, Kans., and the enlargement of the works of the United States Smelting Company at Canon City, Colo. The large plant of the Tri-Bullion Smelting and Development Company, in course of erection at Canon City, Colo., is expected to be completed the latter part of 1908.

Lithophone is an intimate mixture by chemical precipitation of zinc sulphide and barium sulphate. It is now generally manufactured from spelter, but the precipitated zinc sulphide obtained from mine water by the Waring process operated at the plant of E. E. Dwight & Co., near Webb City, Mo., will be used in the manufacture of lithophone. Production was expected to begin early in 1908.

The zinc content of the 1907 production of zinc pigments, as given above, excluding that made from spelter, was 56,931 short tons.

SECONDARY ZINC.

In the ordinary method of galvanizing, where the material to be coated is dipped into a bath of molten zinc, there is great loss of zinc in the form of semioxidized skimmings and of hard zinc drosses, caused by the alloy formed by the zinc with the iron of the tank and of the article to be galvanized. This loss is approximately 50 per cent. In the larger galvanizing plants there are furnaces to refine these skimmings and drosses and recover the spelter. But there are many small independent plants and some large ones which make a practice of buying up galvanized skimmings and drosses and recovering the spelter. Once in a while the zinc smelters running on ore find occasion to work in a quantity of secondary material. In such cases they have made the proper returns to the Geological Survey, and account has been heretofore taken of such production in these reports as dross spelter. A considerable quantity of old metal in the form of various alloys of zinc and copper and other metals is also worked over and brought up to the desired composition by the addition of new metal. In the preparation of this report the attempt was made to get returns of production from as many of these refineries as possible. The table given below embodies the output of 33 of the largest refineries of secondary zinc. The recovery of secondary zinc is rapidly increasing, as is shown by the falling off in exports of zinc dross from 15,887 short tons in 1906 to 8,593 short tons in 1907, and this in spite of a large increase in the use of zinc for galvanizing. The refinery of the Clarksburg Zinc Company, at Clarksburg, W. Va., was completed late in 1907 and operated three months. It has a daily capacity of 7 tons of secondary spelter. On a later page the production of secondary spelter in Europe is given.

Production of secondary zinc in 1907.

Secondary spelter	short tons	18,841
Recovered zinc in alloys	do	1,417
Total secondary zinc	do	20,258

Inasmuch as this secondary spelter takes the place of so much primary spelter, it is to be added to the figures of consumption of zinc in arriving at the actual consumption.

COMPARISON OF STATE TOTALS, BASED ON SMELTER AND ON MINE REPORTS.

The foregoing figures for production of spelter by the respective States are compiled from reports from individual zinc smelters. For several years the production of the more valuable metals in the Western States has been also obtained by the Geological Survey from reports of individual mines. In 1906 the same method was followed in the Atlantic States, and in 1907 this process was extended to cover the whole country. In order to put the smelter production on the same basis as the mine figures, all the zinc which was manufactured into pigment directly from ore (excluding the quantity in zinc oxide manufactured from spelter, the inclusion of which would entail its duplication in the totals) is added to the production of metallic zinc. The zinc recovered from secondary sources is excluded, since it has already been once reckoned as spelter. These facts must be borne in mind in comparing this table with the preceding table. The State totals obtained by each method are compared in the following table:

Comparison of State totals of the production of zinc, based on smelter and mine reports, in short tons.

State.	Totals based on smelter reports.	Totals estimated from mine reports.	Differences.	
			Smelter excess.	Mine excess.
Arizona	89	114		25
Arkansas	1,911	474	1,437	
California	140	116	24	
Colorado	33,644	26,394	7,250	
Idaho	3,508	3,493	15	
Illinois	1,468	737	731	
Iowa	220	145	75	
Kansas	13,850	17,772		3,922
Kentucky	385	0	385	
Maine	1	0	1	
Missouri	142,024	116,752	25,272	
Montana	0	122		122
Nevada	1,692	1,084	708	
New Jersey	59,588	69,369		9,781
New Mexico	1,038	375	663	
Oklahoma	719	1,657		938
Tennessee	181	109	72	
Texas	16	22		6
Utah	2,447	2,726		279
Virginia	771	0	771	
Wisconsin	16,984	18,490		1,506
Total	280,676	259,951		

The smelter State totals represent actual recovery and are found by summing up the total production reported by all companies for each State, respectively, all pigments being recalculated back to equivalent metallic zinc on the basis of average analysis of product. In compiling the mine totals each producing property is requested to report actual tonnage of zinc ores and concentrates shipped, and from this the zinc content is reckoned by assay value. From that zinc content 15 to 25 per cent, according to the character of the ore, is deducted for smelting losses, and the remainders thus obtained from all the producing properties in each State are combined to afford the total for the respective States. It is clear that by either method the correctness of the totals is dependent upon complete and correct returns from every producing mine and smelter. It is further essential to the correctness of the mine totals that the assay content and the theoretical recovery be correctly estimated. Theoretically, the State totals as compiled from smelter reports and from mine reports, respectively, should agree fairly closely. As a matter of fact, they show considerable divergence. These discrepancies, giving rise to "smelter excess" or "mine excess," may be the result of one cause or of a combination of causes, among which are lag in the smelting of the ore; lag in the mining, owing to which the smelter depletes its ore stocks; error in calculating metallic contents from assay and in estimating recovery; and in exact distribution of ore by States according to source. These various causes have been considered somewhat more fully in the lead report.

SMELTER AND MINE STATE TOTALS.

In Arkansas the smelter excess is undoubtedly due to error in apportionment of ore by the smelters. In Colorado the smelter excess, 7,250 tons, partly accounts for the mine excess of 11,027 tons in 1906. The smelter excess in Illinois is probably owing to error in distribution, possibly in part to lag in mining. The mine excess in Kansas is undoubtedly due to error in distribution, the spelter production being partly credited to Missouri, as explained in the lead report. The smelter excess in Kentucky is due purely to lag. The smelter excess in Missouri is partly due to lag (over 10,000 tons of concentrates from Missouri being in stock at one smelter on December 31, 1906) and partly due to error in distribution, ore from Oklahoma and Kansas being attributed to Missouri by the smelters. The smelter excess in Nevada seems to be due to error in the mine total. The mine excess in New Jersey is due to the exportation of zinc ore as noted in the table of exports. The smelter excess in New Mexico is due to the closure of a large mine pending the construction of a reduction plant. The mine excess in Oklahoma has been explained above as the result of error in accrediting the ore to Missouri in the smelter totals. The smelter excess in Virginia is due purely to lag, as the ore was mined in 1906. The mine excess in Wisconsin is probably due to lag, possibly in part to errors in distribution.

REDUCTION.

CONCENTRATION AND SEPARATION.

Progress in methods of concentration has been mainly along two lines, looking toward economy of space and power on the one hand

and toward the more perfect separation of difficult or low-grade ores on the other.

Along the former line there was put on the market during 1907 the pulsator jigs and classifiers designed by R. H. Richards. These compact machines will do the work, it is claimed, of Hartz jigs and spitzkasten, occupying from 75 to 150 times as much space, and at a proportionate saving of power. They have demonstrated their efficiency on the silver-lead and copper ores of Montana, Idaho, Colorado, Mexico, and elsewhere, and have been installed at Flat River, Missouri. In the new Foust jig the essential features are the double system of synchronous plungers with a wide central screen compartment and an automatic discharge which keeps the ore at a certain adjustable depth on the jig beds. The capacity is practically double that of the ordinary jig of the same size, added to which it is claimed that the new jig dispenses with sand jig and concentrating tables. It has been tried with satisfactory results in a number of plants in the Joplin district.

At the Pro Patria plant of the United Rico Mines Company, Rico, Colo., the roasted zinc blende concentrates from the magnetic separator are passed over tables. A much higher grade of zinc concentrates results and a considerable saving of lead is effected. This method will make available large supplies of zinc ore which have hitherto defied commercial separation.

For preliminary roasting of the pyritiferous blende of the Upper Mississippi Valley district several types of rotary cylindrical kilns are in use. An improved circular table roaster adapted to these ores is described by F. H. Trego in the Engineering and Mining Journal.[a]

The 50-ton electrostatic separator of the American Zinc, Lead and Smelting Company, at Platteville, Wis., under construction in the latter part of 1907, was completed and put into successful operation early in 1908. It is equipped with rotary dryer, 3 double Blake-Morscher machines, and 4 Huff electrostatic separators.

New forms of pneumatic or dry concentration tables appeared during the year, and a small plant so equipped was installed by the East Tennessee Mining and Development Company, near Mascot, Tenn.

Various flotation processes, experimentally successful, especially in Australia, have not as yet yielded satisfactory results in practice. The Sanders flotation process, employing a bath of aluminum sulphate in an experimental plant at Marion, Ky., successfully made the difficult separation of fluorspar and zinc blende. A plant employing this process has been installed in the concentrating works of the Tri-Bullion Smelting and Development Company, at Kelly, N. Mex., to separate pyrite from blende. The plant includes 2 tanks of 100 tons capacity each.

SMELTING.

During 1907 several large smelters were completed and extensive additions were made to works already in existence. The smelter of the National Zinc Company, at Bartlesville, Okla., under construction in 1907, was completed at the close of the year, and 2 furnaces were fired up early in 1908. There are 4 furnaces of 608 retorts each. The smelter of the Bartlesville Zinc Company, also at Bartlesville, was completed in 1907 and ran for one month. Its equipment is 6 furnaces, with 3,456 retorts in all. These plants are located in a well-developed gas field, with strong rock pressure, upon which there is not as yet much draft, and these companies, as well as the Lanyon-Starr Zinc Company, will undoubtedly have ample natural gas for some years. The smelter of Hegeler Brothers, at Danville, Ill., is expected to be completed by the middle of 1908. It will start with 2 furnaces and 1,700 retorts and will be fired with producer gas.

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[a] Eng. and Min. Jour., March 30, 1907, pp. 613-615.

Important additions to furnace capacity were made by the Grasselli Chemical Company, at Clarksburg, W. Va.; by the Granby Mining and Smelting Company, at Neodesha, Kans.; by the Cockerill Zinc Company, at Altoona, Kans; and by the New Jersey Zinc Company, at Palmerton, Pa.

> In summing up the status of American zinc smelting at the end of 1907 it is no longer to be said that as compared with European practice it is characterized by backwardness. It is rather to be said that while the European practice excels in some respects the American excels in others. In most matters of mechanical handling and in roasting blende ore the American is decidedly ahead. In the construction of the distillation furnaces and in distillation practice, including the recovery of by-products, the European leads. The cost of smelting is about the same in the two continents. The cheaper labor of Europe is offset by its dearer fuel. In percentage of metal extraction the European smelters, on the whole, have the advantage, but it is not a large one. In conclusion, it may be said that the American zinc-smelting practice, capable as it is of further great improvement, is no longer a branch of metallurgical industry to be ashamed of.[a]

The subject of electro-thermic smelting of zinc ores has received much study and experimentation, and several designs of electric furnaces have been patented. According to W. McA. Johnson,[b] the chief difficulty from a metallurgical standpoint in the use of the electric zinc furnace is to secure the condensation of the zinc vapor on a large scale as metallic zinc and to prevent its coming down as zinc dust.

The De Laval electric cyclon furnace has been operated experimentally for some time at the zinc and silver mines at Sala, central Sweden. At these mines there are enormous piles of zinc tailings, the accumulation of several hundred years of mining. The more recent experiments have proved a decided success, good quantities of zinc oxide being obtained.

The Canada Zinc Company is constructing, near Nelson, British Columbia, a plant equipped with electric furnaces after the patents of Frederick T. Snyder. It is intended to treat zinc-lead ores of the Slocan district. Other types of electric zinc furnaces are those designed by W. McA. Johnson and Gustave Gin.

The experimental attempts to smelt zinc in the blast furnace after the Lungwitz process, carried on at Warren, N. H., have been resumed after an untoward series of delays.

Various chemical and electrolytic processes for the treatment of refractory zinc ores have been proposed, among them the cyclic method of Bechi and R. W. Rucker[c] to boil the finely crushed ore in a solution of ferric sulphate with free sulphuric acid, the zinc going into solution as a sulphate, the lead remaining in the insoluble residue.

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[a] Ingalls, W. R., Lead and Zinc in the United States, Hill Publishing Company, New York, 1908 pp. 334-335.

[b] Electrochem. and Metallurg. Indust., vol. 5, March, 1907, p. 84.

[c] Rev. Chimique, October, 1907; Min. Jour. [London] October 19, 1907, p. 475.

The zinc oxide obtained by calcination of the sulphate is commercially pure and quite free from lead.

The process of W. George Waring (United States patent No. 718554), also cyclic, comprises the recovery of zinc and other metals by precipitation as sulphide from zinciferous mine waters or from the solution obtained by leaching zinciferous tailings with water weakly acidulated with sulphuric acid, or with a solution of ferric sulphate containing some free sulphuric acid. A plant to recover zinc and cadmium under the patent was erected by E. E. Dwight & Co. in 1907 on the site of the old Victor mine, near Webb City, Mo., to utilize the highly zinciferous water which fills the abandoned underground workings of that and neighboring mines.

The American Zinc and Chemical Company, of Denver, Colo., operating the Dewey method of zinc extraction, was unable to make a commercial success of the process and has closed down. The process comprised sulphide roasting, sulphate lixiviation, evaporation, and calcination as zinc oxide.

RESOURCES.

Before the scope of the mines report in these annual volumes was extended to cover the Eastern and Central States, it was appropriate at this point to consider the development of the zinc-mining industry during the year and to take note of discoveries of new zinc resources, both in new territory and in new relations in known territory. Now, however, in the mines report under each zinc-producing State there will be found a more complete account of all that pertains to the resources of zinc than would be expedient here.

TRADE CONDITIONS.

WORLD'S PRODUCTION.

The world's production of spelter in 1907 increased 37,971 tons, or 4.9 per cent. Of this the principal share was contributed by the United States, which exceeded its production of the preceding year by 25,090 tons, or 11.2 per cent. The next large gains were made by Germany and Great Britain, with 4,059 and 3,315 tons each, an increase of 1.8 and 5.7 per cent, respectively. The production of the United States comprised 30.7 per cent, nearly one-third of the entire production of the world. The following totals for foreign countries are those published by Henry R. Merton & Co. (Limited), of London:

The world's production of zinc, 1904–1907, in short tons.

Country.	1904.	1905.	1906.	1907.
Australia	....	....	1,131	1,098
Austria and Italy	10,192	10,315	11,883	12,522
Belgium	154,314	160,496	168,067	170,307
France and Spain	54,107	55,524	59,293	61,438
Germany:				
Rhine district	72,083	74,127	75,729	77,459
Silesia	138,538	143,243	150,282	152,611
Great Britain	50,949	56,140	57,971	61,286
Holland	14,442	15,176	16,150	16,526
Poland	11,693	8,422	10,595	10,735
United States	186,704	203,849	224,770	249,860
Total	693,022	727,292	775,871	813,842
United States percentage of world's production	26.9	28.0	28.9	30.7

PRODUCTION OF SECONDARY SPELTER IN EUROPE.

The following table of the production of secondary spelter in Europe is calculated to short tons from a table published by Rudolf Wolff, Kreuger & Co., of London. The production of the United States is included for comparison.

Production of secondary spelter in Europe and United States, 1905–1907, in short tons.

	1905.	1906.	1907.		1905.	1906.	1907.
Austria-Hungary	3,505	3,674	3,931	Holland	2,268	2,800	2,957
Belgium	4,044	4,473	3,620	Russia	1,680	....	1,680
France	14,304	14,898	15,130	United States	....	....	18,841
Germany	9,689	11,040	11,316				
Great Britain	7,913	7,644	7,168	Total	43,403	44,529	64,643

IMPORTS AND EXPORTS.

Zinc imported and entered for consumption in the United States, 1902–1907, in short tons.

Year.	Block or pigs.		Sheets.		Old.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
1902	448	$36,536	68	$8,339	157	$8,299	$32,708	$85,882
1903	202	19,161	129	8,537	163	11,772	10,376	49,846
1904	341	34,211	17	2,230	36	3,247	10,394	50,082
1905	428	46,295	14	1,953	86	5,110	8,253	61,611
1906	1,021	240,632	22	3,236	79	7,647	2,904	[a] 254,419
1907	1,709	220,474	52	7,158	122	8,582	8,516	[b] 244,730

[a] Not including more than 41,174 short tons of zinc ore, valued at $989,880.

[b] Not including 112,723 short tons of zinc ore, valued at $1,495,329.

The tonnage of a part of the ore imports was not given prior to July 1, 1906.

Exports of zinc ore and of manufactures of zinc of domestic production, 1902–1907, in short tons.

Year.	Zinc ore.		Plates, sheets, pigs, or bars.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
1902	55,733	$1,449,104	3,237	$300,557	$114,197	$1,863,858
1903	39,411	987,000	1,521	163,379	71,354	1,221,733
1904	35,911	905,782	10,147	1,094,490	117,957	2,118,229
1905	30,946	848,451	5,516	682,254	159,995	1,690,700
1906	27,720	733,300	4,670	583,526	204,269	[a] 1,521,095
1907	[b] 20,352	579,490	563	75,194	186,203	[c] 840,887

[a] Not including 15,887 short tons of zinc dross, valued at $1,103,706.

[b] The exports consisted wholly of high-grade willemite ore from New Jersey.

[c] Not including 9,593 short tons of zinc dross, valued at $560,944.

Imports of zinc oxide, 1901–1907, in short tons.

Year.	Dry.	In oil.	Year.	Dry.	In oil.
1901	1,800	64	1905	1,718	171
1902	1,636	82	1906	2,096	146
1903	1,744	83	1907	2,656	181
1904	1,293	112			

Exports of zinc oxide, 1904–1907, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1904	8,157	$628,494	1906	15,578	$1,149,297
1905	11,280	810,203	1907	13,257	1,069,924

Imports of old brass fit only for remanufacture, 1903–1907, in pounds.

[Average composition about one-third zinc and two-thirds copper.]

Year.	Quantity.	Value.
1903	1,216,683	$154,260
1904	2,659,054	310,311
1905	9,676,798	1,169,320
1906	12,938,205	1,891,126
1907	7,957,015	1,344,753
Total	34,447,755	4,869,770

CUSTOMS DUTIES ON ZINC ORES.

The tariff act of 1897 contains the following paragraphs:

ART. 181. Lead-bearing ore of all kinds, 1½ cents per pound on the lead contained therein, etc.

ART. 183. Metallic mineral substances in a crude state and metals unwrought not specially provided for in this act, 20 per centum ad valorem, etc.

FREE LIST.

ART. 514. Calamine.

ART. 614. Minerals, crude or not advanced in value or condition, by refining or regrinding or by other processes of manufacture.

The agitation of the question regarding the classification of certain zinc ores under customs acts and the assessment of duties on them was brought to a head early in 1906. It was originally maintained by certain mine operators, notably those of Joplin, Mo., that under prevailing practices importation by smelter companies of oxidized ores of zinc, which could be both bought and smelted more cheaply than their sulphide ores, tended to injure the zinc-mining industry in this country. Accordingly, on February 12, 1906, the Secretary of the Treasury issued the following order: "You are hereby instructed, following the advice of the Attorney-General, to classify ores chiefly valuable for the zinc which they contain, as metallic mineral substances in a crude state, under paragraph 183 of the existing tariff act, at the rate of 20 per cent ad valorem. You will admit calamine, silicate of zinc, free under paragraph 514." Against this ruling the zinc-smelting interests brought a test case in the name of the Kansas City Smelter Company.

The parties to the controversy presented evidence in support of their respective contentions before the Board of United States General Appraisers. The contention of the importers was that the carbonates and silicates of zinc are free of duty under the provision in paragraph 514 for calamine, and that the sulphides of zinc, or blende, are free under paragraph 614 as crude minerals.

The record in these cases is voluminous, consisting of the testimony of many witnesses on both sides, supplemented by references to and extracts from a large number of scientific authorities.

The conclusion (T. D. 27891) of the Board of General Appraisers was—

> that the carbonates and silicates of zinc are included within the meaning of the term "calamine" as used in paragraph 514, and that they are free of duty under said paragraph and also under paragraph 614, and that the sulphide of zinc is free under the paragraph last named as crude minerals, etc., subject, however, to the qualification that when lead is found in these ores duty shall be taken on the amount of lead contained therein as described in paragraph 181.

The substance and status of the matter was concisely summarized in direct advice of the Secretary of the Treasury to the survey under date of March 25, 1907, in which he said:

> I have the honor to state that the zinc ores are not provided for eo nomine in the tariff act of July 24, 1897, but it is the practice of collectors of customs, approved by this department, to assess duty upon zinc ores other than calamine, under paragraph 183 of the said act, a copy of which is herewith inclosed, as metallic mineral substances in a crude state at the rate of 20 per cent ad valorem. A number of protests filed with collectors against this classification have been decided in favor of the importers, the merchandise being held to be entitled to admission free of duty, under paragraph 614, as crude minerals, and a number of protests against the classification under paragraph 183 are still pending.
>
> Calamine is admitted free of duty under paragraph 514, but the department holds that the term "calamine" should be confined to ores whose component material of chief value is silicate of zinc.

The Government's application for review of the decision of the Board of General Appraisers was brought in the United States circuit court, southern district of Texas, Laredo division, where, April 21, 1908, re United States *v.* Brewster (T. D. 29006), the decision of the board was sustained. The Government took an appeal to the United States circuit court of appeals, fifth circuit, before which the case is now pending. In the meantime duties are collected as indicated in the letter of the Secretary of the Treasury, quoted above, importers entering protest in each case, reliquidation and refund of duties collected to be made on final decision if adverse to the Government.

CONSUMPTION.

In the following tables, showing the consumption of spelter in the world and in the United States for the period 1898-1907, the figures of foreign consumption are computed from statistics published by the Metallgesellschaft and Metallurgische Gesellschaft A-G, of Frankfurt-am-Main, Germany. In those statistics consumption is calculated on the basis of production plus excess of imports over exports or minus excess of exports over imports, and altogether disregards smelter stocks. For the sake of comparison, the consumption of the United States is calculated by both methods. Although in the long run the stocks carried over from one year are consumed in the next and thus are equalized, it can not be gainsaid that for the individual year to take stocks into account gives greater accuracy. A case in point is the consumption of the United States for 1907. As will be noted in the table giving the details of the calculation of consumption in 1907, there was a large stock of spelter on hand at the close of the year. Disregarding this stock, the home consumption appears to be 251,049 tons, when as a matter of fact it was 228,509 tons. To obtain perfectly accurate figures of consumption it would be necessary to consider the stocks in the hands of consumers and dealers and to take into account the secondary spelter consumed. In any event, to the consumption for 1907 as given above, 228,509 tons, there should be added the production of secondary zinc for the year, 20,258 short tons.

World's consumption of spelter, exclusive of secondary zinc, 1898–1907, in short tons.

Year.	United States.		In foreign countries, stocks disregarded.	Total world's consumption, stocks disregarded.	United States percentage of total.
	Stocks considered.	Stocks disregarded.			
1898	108,199	106,185	422,070	528,255	20.10
1899	124,585	123,688	422,181	545,869	22.66
1900	99,399	102,414	420,858	523,272	19.57
1901	141,697	137,789	424,496	562,285	24.51
1902	152,682	154,138	465,391	619,529	24.88
1903	154,381	157,900	480,162	638,062	24.75
1904	180,911	176,894	520,506	697,400	25.36
1905	200,438	198,835	534,285	733,120	27.13
1906	220,781	221,142	556,882	778,024	28.42
1907	228,509	251,049	568,346	819,395	30.64

World's consumption of spelter in 1907, in short tons.

Austria-Hungary	34,171
Belgium	60,627
France	76,720
Germany	192,792
Great Britain	154,653
Holland	4,189
Italy	7,496
Russia	19,290
Spain	5,180
Other countries	13,228
United States	228,509
Total	796,855

Consumption of spelter in the United States, 1906 and 1907, in short tons.

	1906.	1907.
Supply:		
Stock at beginning of year	3,463	3,824
Production	224,770	249,860
Imports for consumption	1,043	1,761
Total available	229,276	255,445
Withdrawn:		
Stock at close of year	3,824	26,364
Exports, foreign, in bond	1	9
Exports, domestic	4,670	563
Total withdrawn	8,495	26,936
Apparent domestic consumption	220,781	228,509

USES OF SPELTER IN THE UNITED STATES.

Statistics regarding the uses of spelter are not collected by the Survey. The following table from figures obtained by Mr. W. R. Ingalls and published in the Engineering and Mining Journal, while not agreeing exactly with results reached by the Survey as to the total consumption of spelter in this country, will nevertheless show the relative quantities of spelter used for different purposes in the United States for the period 1905 to 1907, inclusive:

Uses of spelter in the United States.

	1905.		1906.		1907.	
	Quantity.	Per cent.	Quantity.	Per cent.	Quantity.	Per cent.
	Short tons.		*Short tons.*		*Short tons.*	
Galvanizing	100,000	50	124,000	55	149,000	66.0
Brass making	52,000	26	57,000	25¼	40,000	17.7
Sheet zinc	34,000	17	36,000	16	30,000	13.3
Lead desilverization	2,400	1¼	2,500	1	2,600	1.2
Other purposes [a]	10,854	5¾	6,000	2¾	4,000	1.8
Total	199,254	100	225,500	100	225,600	100.0

[a] The apparent falling off in the consumption of zinc for "other purposes" in 1906 is explained by a more complete itemization of the consumption in 1906; in other words, there was probably more spelter used for brass making in 1905 than the above table shows.

While possibly due in part to further refinement in itemizing, as indicated in the footnote, there has been nevertheless a progressive increase in the quantity of spelter used in the galvanizing industry, which quantity now amounts to two-thirds of the whole domestic consumption of spelter. The increase in consumption for galvanizing purposes equals the annual increase in the production of spelter in this country, and, although in 1907 it was largely compensated by a decrease in the needs of the brass-making industry, nevertheless with the resumption of normal conditions in that industry, the expanding galvanizing industry must absorb the greater part of the normal yearly increase in the production of spelter which averages about 10 per cent.

BEARING ON CONSUMPTION OF NEW PROCESSES OF GALVANIZING.

In ordinary or hot galvanizing the object to be coated is dipped in the molten zinc. This method has the merit of rapidity and continuity of operation, but is wasteful both of heat and zinc. In recent years the electrolytic process has been so improved that it has many advantages over the ordinary method for various classes of work. Probably the most effective arrangement employs a filter bed of zinc dust and carbon to regenerate the electrolyte and bring it up to the proper zinc strength. Within the last few years there have been introduced into the United States the processes known as sherardizing and cowperizing. To sherardize an object it is placed in a drum, the space around it being filled in with ordinary zinc dust, the drum made practically airtight, and the whole kept at a temperature of 500° to 600° F., for from thirty minutes to several hours, depending on the nature of the coating of zinc desired. After the process is complete, the contents of the drum are dumped on a screen, and the zinc dust which has not been consumed in the deposition of the zinc coating falls through to be used later, there being no loss of zinc whatever. Though below the melting point for solid zinc, the object is found to be covered with a uniform coat of zinc. This is due to the fact that zinc dust begins to vaporize at less than 400° F. In addition to the superficial coating of zinc, the iron below is found to be alloyed with zinc for a certain distance from the surface.

If the zinc coating be removed this alloy effectively prevents rusting. In this fact lies the superiority of this form of galvanizing over the ordinary galvanizing, in which, if air has access to the iron beneath through any accidental opening, rusting sets up and may creep along under the zinc coating. In addition to using less zinc, there are other economies of operation which assure the wide use of the process. In cowperizing, the articles are placed in a revolving drum and zinc dust is vaporized in a connecting chamber, the vapor coating the objects much as in sherardizing.

"Electrozincing, sherardizing, and cowperizing all have a large field of application and will greatly increase the amount of iron coated each year with zinc, as each process has its own peculiarities which render it more suitable than any other process for specific purposes, and in many cases enables iron objects to be coated with zinc which could not be done by the process of hot galvanizing."[a]

It is to be noted that zinc is required in the form of zinc dust in each of these three processes which promise to expand widely not only pari passu with the increase of the industry, but also within the industry, and at the expense of the old process. Zinc dust, the "blue powder" of commerce, is a very fine sublimate which comes down in the condensers and prolongs in the distillation of zinc in the ordinary way. It amounts to 5 or 10 per cent of the total yield of spelter. The American practice is to recharge it into the retorts. The zinc dust used in this country is imported from Europe. In a preceding section on improvements in smelting, it was pointed out that the chief difficulty in the electrothermic smelting of zinc is to prevent the zinc vapor from condensing as zinc dust. With two-thirds of the spelter output consumed in galvanizing and with the prospective greatly increased use of zinc dust in that industry, it would seem likely that this difficulty will disappear. Thus the new methods of galvanizing may work a considerable change in the zinc smelting industry.

PRICES.

The year opened with spelter selling at 6.70 to 6.75 cents, the high level reached in 1906. The market held very firm through the first seven months of the year, the principal support being the demand for spelter by the galvanizing industry which shared the exceeding prosperity of the iron and steel industry for the period. Beginning in July prices gradually fell away to the end of the year, closing at 4.10 cents, the lowest figure reached since 1901. The last four months of the year saw the accumulation of larger stocks of spelter at the various works, the increase for the year amounting to 22,540 short tons.

The European market broke early and suffered many vicissitudes, the extreme London prices ranging from £28 2s. 6d. to £19 2s. per long ton (6.10 to 3.78 cents per pound). Preliminary steps were taken in the latter part of the year toward the formation of an organization of the German spelter producers and dealers, with the object of limiting the production and controlling prices for a term of three years. It is expected that ultimately the Belgian, French, and British producers will enter the agreement.

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[a] Electrochem. and Metallurg. Industry, 1905, p. 194.

Price of common western spelter in New York City, 1902–1906, by months.

[Cents per pound.]

Year.	January.		February.		March.		April.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1902	4.30	4.25	4.25	4.00	4.35	4.20	4.45	4.40
1903	4.90	4.55	5.05	4.97	5.75	5.05	5.75	5.50
1904	5.10	4.90	5.10	4.95	5.20	5.05	5.27	5.20
1905	6.20	6.10	6.15	6.10	6.15	5.87	6.00	5.75
1906	6.70	6.00	6.15	6.05	6.35	6.10	6.15	6.05
1907	6.80	6.70	6.90	6.70	6.90	6.75	6.80	6.55

Year.	May.		June.		July.		August.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1902	4.65	4.40	4.85	4.80	5.35	5.05	5.50	5.35
1903	5.80	5.75	6.25	5.75	6.25	5.87	6.00	5.80
1904	5.22	4.95	4.95	4.75	4.90	4.87	5.07	4.90
1905	5.70	5.40	5.35	5.25	5.60	5.25	5.80	5.60
1906	6.10	5.90	6.20	6.00	6.05	5.97	6.05	6.02
1907	6.60	6.35	6.45	6.35	6.35	5.85	5.90	5.50

Year.	September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1902	5.50	5.30	5.50	5.40	5.35	5.10	5.00	4.50
1903	6.10	6.00	6.12	6.00	6.00	5.25	5.25	4.65
1904	5.15	5.07	5.37	5.15	5.80	5.37	6.12	5.80
1905	5.95	5.75	6.15	6.00	6.25	6.10	6.60	6.40
1906	6.35	6.05	6.30	6.15	6.45	6.25	6.65	6.45
1907	5.50	5.05	5.55	5.25	5.25	4.50	4.55	4.10

SUMMARY.

Summary of spelter statistics for 1907.

Production of spelter by United States	short tons	249,860
Consumption of spelter by United States (stocks considered)	do	228,509
Excess of United States production over consumption	do	21,351
Production of zinc by world	do	813,842
Consumption of zinc by world	do	796,855
Excess of world production over consumption	do	16,987
United States percentage of world production		30.7
United States percentage of world consumption		28.7
Rank of United States among zinc-producing countries		First.
Rank of United States among zinc-consuming countries		First.

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QUICKSILVER.

By H. D. McCaskey.

CONDITION OF INDUSTRY.

In general the condition of the quicksilver industry in the United States showed but little improvement in 1907 over that of the previous year. For some time past the metallurgical processes for the recovery of gold and silver have been somewhat less dependent upon the use of this metal than in earlier years, and the demand for it has correspondingly decreased. Furthermore, with increase in recent years of economical methods, characteristic of modern metallurgy, there has been less waste of quicksilver than before. On the other hand, amalgamation mills have increased in number, and with the development of new gold fields the demand for quicksilver for almagamation, for the manufacture of vermilion, and for less important uses, will probably not fall much below the minimum of the last two or three years. The demand from China and Mexico resulted in considerably increased exports during 1907 over those of 1906, but the price obtained during the greater part of the year was not sufficiently attractive to stimulate greatly the industry.

PRODUCTION.

The production of quicksilver in the United States as shown by confidential returns from every producing mine in the country in 1907 was 21,567 flasks, of 75 pounds each, and was valued at $828,931. As compared with the production of 1906 this shows a decrease of 4,671 flasks in quantity and of $129,703 in value. The decrease was general in all of the producing States, though greater in Oregon and Utah than in Texas or California and least proportionately in the last State. The production reported from Oregon, very slight in 1906, was nothing in 1907, and the single producer of Utah reported no production for the last seven months of the year.

The following table shows the production, in flasks of 75 pounds each, and the values for the United States in the years 1906 and 1907:

Production of quicksilver in the United States in 1906 and 1907, in flasks of 75 pounds.

State.	1906.		1907.	
	Quantity.	Value.	Quantity.	Value.
California	20,310	$730,808	17,431	$662,544
Oregon	3	109		
Texas	4,761	178,829	3,686	148,387
Utah	1,164	48,888	450	18,000
Total	26,238	958,634	21,567	828,931

RESOURCES AND DEVELOPMENT.

CALIFORNIA.

During the year 1907 California produced 17,431 flasks of quicksilver, valued at $662,544, a decrease of 2,879 flasks in quantity and of $68,264 in value from the production for 1906. The decrease, however, is less than that shown in 1906, which was 4,325 flasks. The production of California in 1907 was 80.8 per cent of the total production of the United States, an increase of 3.4 per cent since 1906.

Total production of quicksilver in California, 1850–1907, in flasks.[a]

1850	7,723	1870	30,077	1890	22,926
1851	27,779	1871	31,686	1891	22,904
1852	20,000	1872	31,621	1892	27,993
1853	22,284	1873	27,642	1893	30,164
1854	30,004	1874	27,756	1894	30,416
1855	33,000	1875	50,250	1895	36,067
1856	30,000	1876	72,716	1896	30,765
1857	28,204	1877	79,395	1897	26,691
1858	31,000	1878	63,880	1898	31,092
1859	13,000	1879	73,684	1899	29,454
1860	10,000	1880	59,926	1900	26,317
1861	35,000	1881	60,851	1901	26,720
1862	42,000	1882	52,732	1902	28,972
1863	40,531	1883	46,725	1903	30,526
1864	47,489	1884	31,913	1904	29,217
1865	53,000	1885	32,073	1905	24,635
1866	46,550	1886	29,981	1906	20,310
1867	47,000	1887	33,760	1907	17,431
1868	47,728	1888	33,250		
1869	33,811	1889	26,464	Total	2,035,085

The quicksilver industry was not in a flourishing state in California in 1907. The decrease in hydraulic mining of gold, formerly so prominent an industry in California, the decreased amount of gold and silver recovered by amalgamation process alone, and the increased tendency to ship ores of the precious metals to smelters, have all tended to reduce the local demand for quicksilver. Foreign demand, although in general apparently on the decrease also, resulted in increased shipment from San Francisco in 1907, as compared with 1906.

The following table gives the production of quicksilver in California, by counties, in 1906 and 1907:

Production of quicksilver in California, by counties, during 1906 and 1907, in flasks of 75 pounds.

County.	1906.		1907.	
	Quantity.	Value.	Quantity.	Value.
Colusa	13	$488	11	$628
Lake	13	455	657	24,000
Mendocino	50	1,800		
Napa	3,554	126,094	2,600	96,406
San Benito	7,203	254,813	7,685	284,395
San Luis Obispo	3,837	137,955	2,476	98,210
Santa Clara	2,915	109,318	2,518	94,205
Solano	528	20,120	670	30,000
Sonoma	2,031	73,789	716	30,600
Trinity	166	5,976	98	4,100
Total	20,310	730,808	17,431	662,544

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[a] 76½ pounds net; 75 pounds net since June 1, 1904.

The leading quicksilver producing county of California in 1907, as in 1906, was San Benito. This and Lake County were the only two showing increased production over 1906. The second county in point of production was Napa, closely followed by Santa Clara and San Luis Obispo. The chief producing mines in California during 1907 were the New Idria of San Benito County, the Napa Consolidated and the Knoxville of Napa County, the Almaden and the Guadalupe of Santa Clara County, the Cambria, the Oceanic, and the Klau of San Luis Obispo, the St. John of Solano, the Great Western of Lake, and the Great Eastern and the Cloverdale of Sonoma County. In Colusa County the Manzanita mine produced during the year, although the 30-ton mill was operated for only a short time. The New Elgin mines are reported as new producers in this county. In Fresno County the Mercy mines developed some ore, but reported no production of quicksilver, although a new rotary furnace has been recently built to handle about 40 tons in twenty-four hours. In Lake County the Wall Street mine extracted some ore and reported a small number of flasks of quicksilver. The Helen mine also reported considerable development work and produced quicksilver from the new 50-ton furnace. The Great Western mine was an important producer during the year. The plant of this mine is equipped with a 40-ton Litchfield furnace. In Mendocino County the Occident mine reported development work in 1907. In Napa County the Napa Consolidated mine yielded an important production and operated a 60-ton furnace during the year. The Twin Peaks mine also reported a small production following a run of the retorts for a few months. The Knoxville, or old Boston, mine reported a production from mine and retorts. In San Benito County the Bradford mines were being equipped with a 5-ton Scott furnace, and the Florence-Mac mine reported encouraging development work. The Ramirez mine reported a small production. The New Idria mine was again the largest quicksilver producer of the United States. The plant is equipped with 3 furnaces of a daily capacity of 180 tons. The Aurora mine was nonproductive until after the close of 1907, beginning again in 1908. In San Luis Obispo County the Oceanic and the Cambria mines were again important producers. In the Josephine mine recent development work was reported as showing good ore. The Klau mine has recently been sold and extensive operations are planned here according to reports, and the Black Bear, the Big Three, the Luck Star, and the Mountain Quail mines are in course of development. In Santa Clara County the 20-ton Scott furnace and the Silver Creek mine of the Silver Creek Mining Company were not operated, but the Guadalupe mine, equipped with 2 fine and 2 coarse ore furnaces with a daily capacity of 120 tons, reported a production for the year. The well-known New Almaden mine was, as usual, one of the most important producers in the United States. The plant consists of 2 coarse ore furnaces, with a total daily capacity of 40 tons, and with three Scott continuous fine-ore furnaces, with a total daily capacity of 104 tons. The Phoenix mine, which has a modern 60-ton Scott furnace, was not operated in 1907. In Solano County the St. John's Consolidated Quicksilver Mining Company mined considerable ore and produced quicksilver. This company operates 2 coarse ore furnaces and 2 benches of retorts. In Sonoma County the Great Eastern, the Cloverdale, and the Culver

Baer mines were also producers in 1907. The Great Eastern mine is equipped with one 16-ton fine ore furnace and one 12-ton coarse ore furnace. The Culver Bear and the Cloverdale mines are each provided with 18-ton furnaces. The Cinnabar and the Eureka mines both reported development work. The Boston, the Earline, and the Hope properties suffered from forest fires in 1907 and made no production. The plant of the Socrates Consolidated Mining Company was also destroyed by forest fires in the fall of 1907. In Stanislaus County development work was reported from the Phoenix, the Stanislaus, the Hazzard, and the Deer Park mines. In Trinity County the Altoona Quicksilver Mining Company reported a nominal production from their 30-ton furnace.

On the whole, the conditions during the greater part of the year were not of the best. A few operators were still handicapped by losses in the San Francisco earthquake and fire; the market and prices were not attractive; and forest fires destroyed several plants. At the close of the year, however, better prices and the results of development of some new ore bodies gave the general situation a somewhat better tone.

The field relations of the most important of the California deposits have been exhaustively described by Becker and Turner,[a] and some very interesting details have more recently been given by Forstner.[b] Further references to these deposits are given under the bibliography.

TEXAS.

The output of quicksilver in Texas in 1907 as reported by all of the producers to the Survey was 3,686 flasks, of 75 pounds each, valued at $148,387. The production of Texas in 1907 was 17.1 per cent of that of the United States, or 1.0 per cent less of the total production than in 1906. Compared with the figures for 1906 the production of Texas shows a decrease of 1,075 flasks in quantity and of $30,442 in value. This reduction in output was largely due to the greatly curtailed production of two companies which devoted their efforts during the year chiefly to prospecting.

Production of quicksilver in Texas, 1899–1907, in flasks.[c]

1899	1,000	1905	4,723
1900	1,800	1906	4,761
1901	2,932	1907	3,686
1902	5,319		
1903	5,029	Total	34.586
1904	5,336		

The chief producers in Texas in 1907 were the Chisos, the Marfa and Mariposa, and the Lone Star companies, all in Brewster County. The work of the Texas Almaden Mining Company was largely confined to prospecting with the diamond drill. This company operates in connection with its mines a 20-ton Scott furnace. The Lone Star Mining Company reduces its ore in Johnson-McKay pipe retorts, having a maximum capacity of 4 tons a day. The Marfa and Mariposa Company operates two 10-ton Scott furnaces, and the Chisos ore is reduced in a leased 10-ton furnace of the Scott type.

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[a] Becker, George F., Geology of the quicksilver deposits of the Pacific slope, with atlas: Mon. U. S. Geol. Survey, vol. 13, 1888.

[b] Forstner, Wm., The quicksilver resources of California: Bull. California State Mining Bureau, No. 27, 1903.

[c] Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.

The quicksilver fields of Texas have been most recently described by Phillips and Turner,[a] and from their papers and from personal communication from Dr. Phillips to the writer the following brief summary has been chiefly obtained.

The area of chief present importance in the quicksilver production of Texas is about 2 miles wide from north to south, and about 15 miles long from east to west, and lies in the southern part of Brewster County, about 300 miles southeast of El Paso, about 110 miles south of the Southern Pacific Railway, and within 7 miles of the Rio Grande River and the Mexican border; an automobile line and a stage line connect the district with Marfa, a station on the railway. The rocks involved are Lower and Upper Cretaceous sediments, cut by later volcanics. The Lower Cretaceous rocks are: (1) At least 1,000 feet of the Fredericksburg or Edwards limestones, (2) about 100 feet of the Washita or Fort Worth limestone, (3) about 75 feet of Arietina clays or Del Rio shales, and (4) about 75 feet of Vola limestones. The Upper Cretaceous is represented by (5) about 400 feet of Eagle Ford shales, (6) about 100 feet of Austin chalk, and (7) 200 feet of Ponderosa marls. Tuffs and lavas of Tertiary age are represented by andesites, rhyolites, phonolites, and basalts. The volcanics occur as sheets, dikes, laccoliths, and surface flows. Faulting has been a marked structural feature, resulting in mesa topography in a portion of the field. Thrusts were both horizontal and vertical. The strike of the chief dislocation faulting is northwest-southeast, and that of the fissures followed by filling of ore bodies is northeast-southwest. The horizontal thrust faults show less permanence in depth than those of vertical movement. Shearing and friction breccia accompanied faulting, especially in the limestones. Ore has so far chiefly been found in the Washita and Fredericksburg limestones. A productive area of 25 square miles has been prospected in these rocks. A more recent development has been in the Eagle Ford shales, in which an area of about three square miles has been proved ore-bearing. The volcanics seem to be closely related with the ore deposits, and their intrusions may have marked the beginnings of deposition, although there is no definite evidence that any of these rocks are the source of the ore. In the lower limestones the ore bodies are chiefly in calcite veins striking northeast-southwest with varying dip departing usually but little from the vertical. Among these are the Terlingua, Lone Star, Mariposa, Tierra, and Texas lodes. The lodes in the Lower limestones are either calcite or friction-breccia lodes. Some caves have also been found in the limestones, in which occur ores apparently of secondary origin. In the Eagle Ford shales occur the Chisos and the McKinney-Parker lodes. The veins are thought by Turner to be cross-fissure veins. The ore of the Terlingua deposits is chiefly cinnabar, often closely associated with pyrite, or its oxidation products, especially in the breccia lodes. Pyrite is also reported abundant in some of the lavas and shales. The chief gangue material is calcite. Gypsum, regarded by Turner as secondary, is also common in the friction-breccia lodes. Hydrocarbons occur in a few of the Texas ore bodies so far worked, but are rare in the lower limestones. A particularly interesting feature of the Terlingua deposits has been the presence of three new oxychlorides of mercury, terlinguaite, eglestonite, and montroydite, associated with native mercury and frequently with gypsum. The ore treated in the furnaces varies in richness from 0.75 per cent to 2.5 per cent of metal, and that in the retorts runs 4.0 per cent and over. The principal fuel has been wood, which is neither plentiful nor cheap. Near-by deposits of coal may furnish future supplies. Water has also been scarce in the district, and the haulage to the nearest railroad point has been an obstacle to development. Considerable underground and surface work, however, have tended to increase, rather than limit, the prospects for production, according to latest reports. While a number of lodes have pinched in depth, the deepest shafts in others have shown good ore. The greater part of the production has been from surface workings, and the underground reserves are not yet fully known.

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[a] Phillips, William B., The Quicksilver deposits of Brewster County, Texas: Econ. Geol , vol. 1, p. 155, 1906.
Turner, H. W., The Terlingua quicksilver deposits: Econ. Geol., vol. 1, p. 256, 1906.

UTAH.

The only producer in Utah in 1907, as in 1906, was the Sacramento Gold Mining Company at Mercur. This company produced quicksilver during the first five months of the year only and is to be credited with an output of 450 flasks, valued at $18,000. Compared with the figures for 1906, this shows a decrease of 715 flasks in quantity and of $30,888 in value.

Although the company has been an important producer of quicksilver for several years, this industry is subordinate in its interests to the mining of gold. The ore so far worked has carried 6 per cent and over in metal and has been treated in a small plant of 6 retorts. The ore consists of earthy cinnabar in siliceous gangue and is contained in cherty limestones. Other deposits of cinnabar on the property, carrying lower grades of ore, have not yet been extensively developed.

OREGON.

Oregon has been credited with a small annual production of quicksilver for a number of years, and considerable exploration work and several reduction plants have shown an active interest in this industry. The total production to date has been insignificant, but it is possible that future developments at some of the mines may prove important. In 1906 the State was credited with 3 flasks, valued at $109; in 1907 no production was reported. The Colonial Mining Company, however, operating at Black Butte, reported a year of exhaustive experiments with the Dennis 36-ton 3-tile furnace built on new lines, and that ore was running in the furnace in 1908.

NEVADA.

There is no record of the production of quicksilver in Nevada, but deposits of cinnabar have been known, prospected, and developed for many years. In Humboldt County considerable recent development is reported upon claims in Eldorado and American canyons. The Nevada Almaden Mining Company has prospected a large area in

American Canyon and reports the recent discovery of several important ore shoots in a well-defined lode. This canyon has also produced considerable placer gold. Above the claims of the Nevada Almaden Company lies the Dixie group, upon which has been found a vein of white quartz carrying cinnabar. In Eldorado Canyon this company reports the opening up of a considerable tonnage of 2.4 per cent ore in limestone in the Ruby mine, which has been under development for the last two years. Deposits of quicksilver have also been prospected in the Antelope Range about 20 miles north of the Nevada Sulphur mine, in Humboldt County. In Nye County, in the Ione or Union district, development of promising cinnabar ore in limestones at or near the contact with igneous rock is reported. In this county also reports indicate work upon ore of promising grade in the South Bullfrog district. Deposits at Belmont were noted by Becker[a] many years ago.

ARIZONA.

Arizona has not yet become a producer of quicksilver, but considerable development work has been done during the last few years by the Colonial Mining Company and by the Dangerfield interests upon a lode said to be traceable for 3 miles about 12 miles north of Quartzsite, in Yuma County. A new 30-ton furnace has been erected upon the property of the Colonial Company, and production is expected in 1908. The underground work is reported to have reached the 500-foot level and to show important supplies of good ore, which is said to carry additional values in silver and gold.

WORLD'S PRODUCTION.

The table following gives the world's production of quicksilver for the years 1902–1906. From the last annual publication of the Metallgesellschaft and the Metallurgische Gesellschaft were obtained the figures for quantities produced by foreign countries in 1905 and 1906. The values for foreign countries for 1905 were computed at $1,058 per metric ton for 1905 (based on the London average price for the year) and at $1,034 for 1906. The figures for the United States are those of the Survey given elsewhere in this report. Statistics of world production for 1907 are not yet available.

World's production and value of quicksilver in 1903–1906, in metric tons.[b]

Country.	1903.		1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	1,237	$1,544,934	1,188	$1,503,795	1,036	$1,103,120	892	$958,634
Austria	520	621,753	536	602,238	570	603,060	577	596,739
Italy	314	373,065	355	396,335	369	390,402	418	432,300
Russia	362	430,196	393	441,597	318	336,444	210	217,184
Spain	914	1,092,239	1,020	1,146,132	853	902,474	1,300	1,344,473
Total	3,347	4,062,187	3,492	4,090,097	3,146	3,335,500	3,397	3,549,330

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[a] Becker, G. F., op. cit., p. 385.

[b] Mexico reported 335 tons of quicksilver in 1901, 190 tons in 1904 and 1905, and 200 tons in 1906.

Spain.—From this table it will be noted that in 1906 Spain again became the largest producer of quicksilver in the world, the United States changing places with that country and taking second rank. Practically all of the production of Spain is from the famous old mines of Almaden, where about 4,000 men are employed. Conditions having been unsatisfactory at these mines for some time past, according to the "Rassegna Mineraria,"[a] a commission was appointed to investigate. The report of that commission shows that above the twelfth level there are reserves of more than 400,000 tons of ore, equivalent to about 1,000,000 flasks, or about twenty-five years' supply. Below this level at least 800,000 flasks more are in reserve. Exploration has proved the continuity of the great ore deposits to the west and the probability of sufficient ore to enable this mine alone to dominate the world's market and trade. Improvements recommended over present methods are adoption of gobbing, machine drills, modern explosives, artificial ventilation, better internal and external means of transportation, the erection of Cermak-Spirek furnaces instead of the present inefficient and dangerous Bustamente and channel furnaces, and reorganization of management.

Italy.—The only producing mines of Italy are those of the Monte Amiata district in Tuscany. The greater number of ore deposits outcrop along the valley of Fiora River, and occur in a metalliferous zone, containing ores of mercury, antimony, arsenic, and iron, and extending from Monte Amiata, with an elevation of 5,700 feet, to the Tyrrhenian Sea, a distance of 28 miles. The deposits are in impure limestones of the Lias and Eocene. The ores now worked carry less than 1 per cent of metal, and the success of this district is largely due to the metallurgical skill of the late Vincenzio Spirek, whose furnaces have proved so highly efficient and profitable that they have been installed at the Almaden mines in Spain, the Idria in Austria, and elsewhere, to solve the problem of low grade ores, which is the almost universal problem of the industry to-day. Italy produced 423 metric tons of quicksilver in 1907.

Mexico.—The great importance of the silver industry in Mexico and the extensive use of amalgamation processes there in the recovery of this metal tend to give particular interest to the use of local deposits of cinnabar as sources of supply. The Mexican production, however, never satisfactorily reported, seems for many years to have been insignificant. The result is a large annual importation of quicksilver from the United States. Should local deposits be actively developed in Mexico and modern furnaces be installed, it seems probable that not only would much of this market for the United States product be cut off, but many low grade silver mines might be profitably worked owing to decreased amalgamation costs.

The best known deposits of Mexico are probably those of Guadalcazar in San Luis Potosi, of Huitzuco and Tasco in Guerrero, and of San Ofre in Queretaro. Numerous other localities have produced promising samples or prospects and small quantities of metal. The ores usually average not more than about 1 per cent of metal; but mining and metallurgical methods have usually been so wasteful that the real possibilities of the deposits are very little known.

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[a] Min. Jour., London, September 28, 1907, p. 385; Eng. and Min. Jour., December 7, 1907, p. 1063

Austria.—The most important quicksilver producers in Austria, the third country in point of output, are the famous Idria mines. These have annually furnished from 500 to 600 metric tons of metal for many years, and have been well developed and under good management.

Russia.—The quicksilver output of Russia has been steadily decreasing for several years. The production of metal was only 130 metric tons in 1907, as compared with 210 in 1906. Practically all of this was from the Nikitovsk mines.

Turkey.—In Asiatic Turkey there are two quicksilver mines owned by an English syndicate and reported as producers by Monachi.[a] These are the Kara Bournou, 30 kilometers from Smyrna, and the Koniah, in the center of Anatolia.

At Kara Bournou the ore occurs as cinnabar in greatly distorted metamorphic schists in the vicinity of basalts. Mining has been by open work and at low costs. In 1905 there were 3,000 metric tons of 2 per cent ore ready for the furnace. Two double Spirek tower furnaces for broken ore and a Cermak-Spirek furnace for fine ore were installed in 1906, and since May of that year have been in operation producing from 250 to 275 flasks per month. The plant has a capacity of 40 metric tons of ore per diem and can profitably treat ores of 0.25 per cent of metal. The Koniah mine, at the historic town of the same name, has been intermittently worked since the beginning of the Christian era. The ore occurs in siliceous limestones. After recent development considerable ore was exposed and 2 Cermak-Spirek furnaces, with a total daily capacity of about 22 metric tons, were installed. The ore averages about 1 per cent of metal. Labor at these mines is both satisfactory and cheap.

Algeria.—The occurrence of quicksilver in Algeria has been known for many years, but detailed information is lacking. A production of 200 metric tons of quicksilver ore valued at $584 was reported for 1906.

Transvaal.—Surface deposits of quicksilver in metallic form have recently been reported from near Hector Spruit on the Delagoa Bay railroad. The occurrence, however, is in the beds of two creeks, and the origin is unknown.

Philippines.—Reports have frequently been made of deposits of cinnabar in Masbate Island, and in Zambales and the Camarines provinces of the island of Luzon. No details are yet available, and, so far as known, no mining claims have been taken up. The writer has been assured on the authority of Spanish priests, American prospectors, and an English mining engineer, however, that on Mount Isarog, a volcano in the Camarines, there occur promising deposits, both of quicksilver and cinnabar.[b]

China.—The best known quicksilver deposits in China are in Kweichow Province, where the Wan Shan Chang mines, about 1,324 miles from Shanghai, have been worked for about six hundred years. The ore is reported to be cinnabar in dolomites and irregular in form of deposits. The Chinese use the crudest methods of mining, and as the superficial deposits have probably been mostly worked out the annual production is now very small. The ores are reduced in retorts of rough make, and the losses in treatment are probably 40 per cent of the metal in the ores. The product is used in China for making vermilion, for which there is a greater demand than local supplies of mercury can furnish.

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[a] Monachi, F. P., Cinnabar mines in Turkey: Rassegna Mineraria, April 11, 1908—translated for Min. Jour., London, April 25, 1908, p. 517.

[b] McCaskey, H. D., Fifth ann. rept. Mining Bureau, Manila, 1905, p. 32.

Japan.—The quicksilver deposits of Japan have not been very productive so far as known. In 1906 the total value of the output was given as $396 as compared with $390 in 1905.

METHODS OF REDUCTION.

Cinnabar, the chief ore of quicksilver, is readily decomposed by heat, giving off, with access of air or when retorted with quicklime, vapors of mercury, and sulphur dioxide, or calcium sulphide and sulphate. Following are the reactions:

$$\begin{aligned} HgS + 2O &= Hg + SO_2 \\ 4HgS + 4CaO &= 4Hg + 3CaS + CaSO_4 \end{aligned}$$

By subsequent condensation the mercury is collected. The theory of the metallurgy of quicksilver is thus simple, but the practice is uniformly difficult. Low grade ores, and impurities, particularly of a sooty kind, have required the highest metallurgical skill in their treatment. Efficient condensation is particularly difficult. Originally, when rich ores were more plentiful, retorts of a simple kind were largely used. These are short-lived, however, of limited capacity, costly in operation, dangerous to the health of employees, and wasteful, although they yield a very pure product. Retorts are now much improved, but their use is chiefly confined to the treatment of rich ores (over 4 per cent), mercurial soot, or concentrates, or to small mines or undeveloped districts. Modern furnaces for low grade ore are constructed of the shaft type for both fine and coarse ore, and are capable of treating at a profit mine material carrying 0.25 per cent of metal. The Hüttner and Scott furnaces in this country are a successful example. These are brick shaft furnaces, externally fired, and built to treat coarse ore, *granzita* (of 3.2 to 1.2 inches cube), and fine ore, *tierras* (less than 1.2 inches cube). The Scott furnace used at Terlingua, however, is a modification built to handle ores of varying size and for condensation by air cooling alone, as water is scarce in Trans-Pecos Texas. The ore is charged at the top of the shaft and works downward against the furnace and flames on shelves set at angles of 45°, yielding its metal contents in volatilized form together with sulphurous gases in its descent. The fumes are led off into water-cooled condensing chambers. Air for the furnaces is brought in over the cooling discharge products, thus becoming heated and at the same time carrying volatile mercury that would otherwise be lost back to the furnace. The ore is in the furnace about thirty hours. These Scott furnaces are now built to handle 50 tons of ore in twenty-four hours, and the modern forms are highly efficient, free from danger to employees, and operating at low costs. For detailed descriptions the reader is referred to the appended bibliographical list.

TRADE CONDITIONS.

In 1907 the world's market for quicksilver showed little improvement over the unsatisfactory conditions of 1906. The chief cause of the low prices of this metal is undoubtedly the decrease of hydraulic mining and the growing independence on the part of metallurgists of amalgamation as a process for recovery of silver. Prices at the end of 1907 were greatly improved, but the effect upon the industry was not marked. The greatest demand was that of the United States.

IMPORTS AND EXPORTS.

According to returns from the Bureau of Statistics of the Department of Commerce and Labor, the imports of quicksilver into the United States in 1907 greatly exceeded those of previous years, amounting to 16,567 pounds with a value of $6,719, and the exports were lower than for many years, being only 5,132 flasks, valued at $192,094. Of the 16,567 pounds imported, 15,274 pounds were imported during the first six months of 1907. The result is a balance of trade in favor of the United States of only $185,373 as compared with $243,864 in 1906.

Quicksilver imported and entered for consumption in the United States, 1901–1907, in pounds.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1901	1,441	$789	1905	2,690	$1,710
1902	(a)	2,166	1906	84	50
1903	(a)	1,065	1907	16,567	6,719
1904	(a)	1,405			

a Not stated.

Exports of quicksilver from the United States, 1901–1907, in flasks.[a]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1901	11,219	$475,609	1905	13,534	$489,756
1902	13,247	575,099	1906	6,456	243,914
1903	17,577	719,119	1907	5,132	192,094
1904	21,064	847,108			

[a] Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.

The imports were almost entirely into the port of New York, where they amounted to 15,939 pounds, valued at $6,414, from Canada, and 520 pounds, valued at $230, from Germany.

The distribution of exports from the United States by foreign countries to which exported is given as follows:

Exports of domestic quicksilver from the United States in 1907, by foreign countries, in pounds.

Country.	Quantity.	Value.	Country.	Quantity.	Value.
Canada	34,364	$18,204	Cuba	225	$116
Costa Rica	3,750	1,961	Colombia	370	248
Guatemala	150	78	Ecuador	534	339
Honduras	17,546	9,308	Peru	86	54
Nicaragua	1,545	851	Hongkong	150,000	63,787
Panama	176	90	Japan	750	320
Salvador	677	315			
Mexico	174,740	96,423	Total	384,913	192,094

Following are given the exports from San Francisco, the most important shipping point for 1906 and 1907:

Exports of domestic quicksilver from San Francisco in 1906 and 1907, by countries, in flasks.[a]

Country.	1906.		1907.	
	Quantity.	Value.	Quantity.	Value.
China (Hongkong)	503	$16,631	2,000	$63,787
Mexico	1,639	61,132	1,706	67,170
Japan	602	22,688	10	320
Honduras	600	23,350	234	9,308
Korea	37	1,347	2	78
Costa Rica	8	302	50	1,961
Salvador	18	684	8	268
Nicaragua	2	82	....	....
Canada	218	7,697	7	272
Total	3,627	133,913	4,017	143,164

[a] Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.

From these tables it will be noted that although the exports from the United States as a whole decreased in 1907, as compared with those of 1906, the total exports from San Francisco showed an increase. Shipments to China from this port were quadrupled and those to Mexico showed a slight increase; shipments to Japan, Honduras, and Canada, however, showed a material decrease as compared with those of 1906.

PRICES.

Prices of quicksilver in the United States were slightly better in 1907 than in 1906. In New York the price in 1907 was $41.25[a] per flask for the first two months, dropping to $41 in March, where it remained until August and September, when it was $40 per flask. In October the price rose to $40.50, and in the last two months of the year it stood at $45. In San Francisco the price (domestic) began in January at $39.50 per flask, dropped in February to $39, and in March to $38.50, where it remained until August, when it declined further to $38 per flask. In September the price rose to $38.05, in October to $38.19, and in November and December to New York prices of $45 per flask. Quicksilver for export was quoted in San Francisco at $37.50 in January, $37.37 in February, $37.25 from March to July, inclusive, $36.75 in August, $36.70 in September, $36.50 in October, and $43.50 the last two months of the year. The average prices given by the Engineering and Mining Journal for the year 1907 were, therefore, New York $41.50; San Francisco, domestic, $39.60, export $38.17. The average price reported by producers to the Geological Survey in 1907 was $38.43½ per flask.

In London the Rothschild's price averaged £7 0s. per flask for the first eight months of the year, rising in September to £7 4s., falling in October to £7 2s., and rising to £8 5s. for the last two months. This would be an average London price of £7 5s. for the year.

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[a] Eng and Min. Jour., New York, January 4, 1908, p. 89.

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BAUXITE AND ALUMINUM.

By W. C. Phalen.

BAUXITE.

PRODUCTION.

The production of bauxite in the United States in 1907 amounted to 97,776 long tons, valued at $480,330. This is an increase of 22,444 tons, or almost 30 per cent, over the production of the year before, and an increase in value of $112,019, or a little over 30 per cent. The average price of the material at the mines was about $4.91 per long ton, an advance of but 2 cents over the returns for 1906.

Tennessee has been added to the list of producing States in the southern Appalachian field, but the returns from this State are not listed separately, as only one firm was engaged in active mining. Though Arkansas still leads in total production, the output from Georgia, Alabama, and Tennessee increased in 1907 over 50 per cent as compared with an increase of about 20 per cent in Arkansas. A few hundred tons of ore mined in the State of Georgia, but not sold, have been omitted from the total. The following table gives the production and value of bauxite from 1889 to 1907, inclusive:

Production of bauxite in the United States, 1889–1907, by States, in long tons.

Year.	Georgia.	Alabama.	Arkansas.	Total.	Value.
1889	728	----	----	728	$2,366
1890	1,844	----	----	1,844	6,012
1891	3,301	292	----	3,593	11,675
1892	5,110	5,408	----	10,518	34,183
1893	2,415	6,764	----	9,179	29,507
1894	2,050	9,016	----	11,066	35,818
1895	3,756	13,313	----	17,069	44,000
1896	7,313	11,051	----	18,364	47,338
1897	7,507	13,083	----	20,590	57,652
1898	----	----	----	25,149	75,437
1899	15,736	14,499	5,045	35,280	125,598
1900	19,739		3,445	23,184	89,676
1901	18,038		867	18,905	79,914
1902	22,677		4,645	27,322	120,366
1903	22,374		25,713	48,087	171,306
1904	21,913		25,748	47,661	235,704
1905	15,173		32,956	48,129	210,292
1906	25,065		50,267	75,332	368,311
1907	----		----	[a]97,776	480,330

[a] Production of Tennessee included.

CONSUMPTION.

In order to show the annual consumption of bauxite and its value in the United States during the last five years, the following table has been compiled, which includes the annual production, imports, and consumption, together with the value of each, respectively:

Production, imports, and consumption of bauxite in United States, 1903–1907, in long tons.

Year.	Production.		Imports.		Consumption.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	48,087	$171,306	14,889	$49,684	62,976	$220,990
1904	47,661	235,704	15,374	49,257	63,035	285,961
1905	48,129	240,292	11,726	46,517	59,855	286,809
1906	75,332	368,311	17,809	63,221	93,141	431,532
1907	97,776	480,330	25,066	93,208	122,842	573,538

WORLD'S PRODUCTION.

The following table shows the world's production of bauxite in 1904, 1905, and 1906:

World's production of bauxite, 1904–1906, in long tons.

Country.	1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	47,661	$235,704	48,129	$240,292	75,332	$368,311
France	74,449	131,229	101,378	205,738	115,926	229,952
United Kingdom	8,700	8,340	7,300	8,880	6,654	13,274
Total	130,810	375,273	156,807	454,910	197,912	611,537

NOTES ON THE BAUXITE INDUSTRY.

INTRODUCTION.

Many changes have taken place in the bauxite industry during the year 1907, all in the direction of extended development. Numerous new occurrences have also been reported. The American Bauxite Company has disposed of its interests in Arkansas, which were purchased late in 1906 by the Republic Mining and Manufacturing Company of Philadelphia, and on the first day of January, 1907, the Pittsburg Reduction Company changed its name to the Aluminum Company of America. Certain Illinois capitalists have purchased 500 acres of land near Detonti, Ark., with a view to the development of the bauxite deposits upon it. The Tennessee deposits near Chattanooga were worked for the first time by the National Bauxite Company, and discoveries of the mineral are reported from McIntyre and Toomsboro on the Central of Georgia Railway, Wilkinson County, Ga. Occurrences of the mineral have also been reported from Yuba, Shasta, and Nevada counties, Cal., and from near Gaffney, S. C.

DOMESTIC DEPOSITS.

Tennessee field.—The deposits in Tennessee are situated on the southeast slope of Missionary Ridge near Chattanooga. They are most conveniently reached by trolley to Sherman Heights, and are about half a mile south of the tunnel of the Southern Railway Company, which pierces the Ridge in this suburb. These deposits are of the same nature as those farther south in the Georgia-Alabama field, and indeed they may be best described as a northern continuation of the older and better known field. The ore is found in the Knox dolomite near a fault line along which the Knox has been overthrust from the southeast upon the Chickamauga and Clinton (Rockwood) formations lying to the northwest.[a] These geologic and structural conditions are essentially identical with those described by Hayes in Georgia and Alabama. The extension of such deposits to an area far north of that already known emphasizes the value of a close study of the structure in the Cambrian and Cambro-Ordovician rocks in the southern Appalachian region in all future attempts to extend the bauxite-bearing areas.

The Chattanooga deposits are worked by the National Bauxite Company, which has opened thus far two pits situated within 250 yards of each other on a northeast-southwest line. The northeast pit is known as the Perry mine, and was not working when visited in November, 1907, though all the ore in it had not been exhausted; the southwest pit had been excavated from 40 to 50 feet below the surface, the ore being hauled out by stationary engine over a short incline. The amount of surface stripping required to reach the ore was notably small, not more than 4 or 5 feet.

The ore is as a rule light in color. Some in the Perry mine is of the compound pebble variety; some is of the pisolitic and oolitic varieties, and the latter, by a decrease in the number of oolites, becomes what is locally known as "block" ore. This is a fairly compact, light to dark olive-gray ore with an occasional pisolitic and oolitic grain. It is rich in alumina and low in both iron and silica. The bauxite is, of course, associated with more or less clay. There is also in the southwestern pit a body of lignite overlying the "block" ore. This lignite mass is roughly triangular in cross sections with sides about 6 feet long, and extends the entire width of the pit. Lignite masses were noted near Fort Payne, Ala., and Hayes mentions a similar occurrence in the Dike district in the same State.[b] The deposits controlled by the Aluminum Company of America are farther south on the Ridge, and have not yet been worked. Further prospecting in this locality will undoubtedly bring to light other deposits of bauxite.

Georgia-Alabama field.—In the Georgia-Alabama field deposits of bauxite are known to occur intermittently in a northeast-southwest zone extending from Adairsville, Bartow County, Ga., to Jacksonville, Ala. Most of the deposits that have been worked or are now being worked are centered near Hermitage and Cave Spring, Ga., and Rock Run, Ala.; but it is probable that some deposits in addition to those at present known will be found in the intervening and outlying territory. Among the isolated deposits is the Bigelow mine, formerly owned by Harrison Brothers, of Philadelphia, but now by the

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[a] Hayes, C. W., Geologic Atlas U. S. [Chattanooga], folio 6, U. S. Geol. Survey, 1894.
[b] Hayes, C. W., Sixteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1894, p. 584.

National Bauxite Company, of Rome, Ga. This mine is situated 12 miles south of Rome. Another is situated at Summerville, Chattooga County, Ga. A shaft has been sunk on the deposit, which is situated northwest of the town, and several carloads of ore have been shipped. According to Burchard [a] the bauxite occurs in pisolitic and cellular forms, and also as the massive variety associated with chert and limonite. The greater part of the ore is so impure as to need washing before it can be marketed.

Near Hermitage four operations were more or less active during the year 1907. Among the larger companies, the Republic Mining and Manufacturing Company, of Philadelphia, has worked the Julia and the Ward mines, located, respectively, 5 miles east and 2 miles south of Hermitage. The company operates two driers, one at the Julia mine and one at Hermitage—the latter taking care of the product of the Ward mine and of that obtained in small quantities from miscellaneous sources. The Aluminum Company of America is working at South Waters, about 3 miles south of Hermitage, and Mr. John H. Hawkins, of Rome, Ga., is working a deposit about 5½ miles southeast of the same town. There is a drier located near Mr. Hawkins's mine.

About 1 mile southeast of Cave Spring the old Gordon deposit was worked during the year by the National Bauxite Company. The mine is located near the hilltop, and five or six irregular pockets are now being worked in the same pit. These irregular bodies were formerly connected with the main mass, which has been entirely worked out. The ore mined here is high grade, and carries very little iron oxide. The company has also maintained a steady output from the Hebble mine, situated on the Hampton property, about 4 miles south of Cave Spring. This is one of the largest openings in the district. The ore is shipped to Rome, where it is dried in the capacious drier recently erected by the company. About 1½ miles north of the Hebble mine the Aluminum Company of America is operating the Reese mine. The mass of ore seen here is extremely irregular, and much expensive deadwork seems to be necessary before the main deposit is well exposed. The material is hauled to Cave Spring, whence it is shipped after drying. Three miles southeast of Cave Spring on the Cedartown road several prospects indicate the presence of ferruginous bauxite. A few shallow holes represent all the work done to date.

Near Rock Run, Cherokee County, Ala., the Republic Mining and Manufacturing Company employs from 20 to 25 men at the Dike mine. The pit is a deep one, and the ore is removed on a steep incline. The mine is now nearly worked out, but the company controls other properties in the vicinity which may be drawn upon in the future. A drier is operated in the vicinity. The Monahan mine, about 1 mile southeast of the Dike, is controlled by the Aluminum Company of America. This is a recent opening, triangular in horizontal section, about 100 feet long, 50 feet at its greatest width, and about 40 feet deep. It has a section somewhat as follows:

Surface soil	6 feet.
Mottled clay	18 to 20 feet.
Bauxite	10 to 15 feet.

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[a] Burchard, E. F., Bauxite and aluminum: Mineral Resources U. S. for 1906, U. S. Geol. Survey, 1907, p. 503.

The material appears to be irregularly stratified, with a dip between 30 and 40 degrees in the direction N. 30° W. Another pit belonging to the same company is situated a short distance northeast of the Monahan mine.

New bauxite field in Georgia.—The Survey has received during the winter of 1907–8 specimens of bauxite from Toomsboro on the Central of Georgia Railway in Wilkinson County, and Mr. Otto Veatch, of the Geological Survey of Georgia, has recently described an occurrence of the mineral about 1½ miles north of the Central of Georgia Railway and 3 miles east of McIntyre, which, in turn, is about 7 miles west of Toomsboro. According to Mr. Veatch's interesting account,[a] the deposit is in no way connected with those of northwestern Georgia, either geographically or geologically, being located about 150 miles distant and in the Coastal Plain. It lies near the northern margin of the Coastal Plain, and occurs in the Tuscaloosa formation of probably lower Cretaceous age. It is overlain directly by red sands and impure clays of Eocene age. The strata in the vicinity are for the most part unconsolidated sands and clays having no pronounced structural features; the beds lie almost horizontal, having only a slight dip southward.

The bauxite occurs in blanket form, its lateral extent greatly exceeding its thickness. The position of the bed can be traced by small fragments at the surface for a distance of about one-half mile, and it maintains a rather uniform level. It lies near the contact of the red argillaceous Eocene sands and a bed of white and stained massive clay. Mr. Veatch offers the tentative opinion that the bauxite is an alteration product of the bed of white clay or kaolin and has resulted from desilication of the kaolin.

The mineral is pisolitic, and varies in color from bright red to yellow and cream. The pisolites are generally quite small, the majority varying from one-tenth to one-half inch in diameter; they may either make up the entire mineral or may be scattered in the amorphous matrix. The bauxite is hard at the surface, although it will doubtless be found much softer where it is under cover.

Three samples were collected by Mr. Veatch from the outcrops. These were analyzed by Dr. Edgar Everhard, chemist of the Geological Survey of Georgia, with the following results:

Analyses of bauxite from Wilkinson County, Ga.

	1.	2.	3.
Alumina (Al_2O_3)	57.58	52.92	55.21
Silica (SiO_2)	9.38	10.17	12.40
Iron oxide (Fe_2O_3)	.96	7.66	.96
Titanium oxide (TiO_2)	2.76	2.30	2.15
Combined water	29.12	26.55	29.10
Moisture	.35	.35	.33
	100.15	99.95	100.15

The second analysis represents the most ferruginous of the samples, which was bright red in color. The clay underlying the bauxite approaches a kaolin in composition, except that it is in places highly stained with iron oxide.

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[a] Eng. and Min. Jour., April 4, 1908, p. 688.

The lateral extent of the deposit has not yet been determined, and the total quantity of the bauxite can not yet be estimated. However, it is known to reach a thickness of 10 feet, and from the outcrops and a small amount of prospecting, it is estimated that 100,000 long tons occur at the point of discovery; this quantity will probably be increased by further prospecting. The overburden consists of unconsolidated sand, and will vary from a few feet with a gradual increase to 40 feet, provided that the bed is extensive laterally. The mining of the ore should present no special difficulties, and water for power and other purposes is abundant.

Arkansas field.—The deposits worked in Arkansas are located in Saline and Pulaski counties, and are controlled chiefly by the Aluminum Company of America, with smaller holdings by the National Bauxite Company and the Republic Mining and Manufacturing Company. The National Bauxite Company has done no work in the Arkansas field during 1907. The Aluminum Company of America has done considerable development work at Bauxite. It also completed during the year a large new crushing, grinding, and drying plant. It has built a new railroad called the Bauxite and Northern, connecting all of its mines in that region with the Chicago, Rock Island and Pacific Railroad and the Missouri Pacific and Iron Mountain systems.[a] The acquisition of land by Illinois capitalists in this field has been referred to.

FOREIGN DEPOSITS.

India.—It has recently been claimed that a source of aluminum might be found in India, where thousands of square miles are covered with deposits of aluminous laterite. True laterite is essentially a mixture of iron hydrate, aluminum hydrate, and free silica in varying proportions. It is identical in type with bauxite, being merely an iron-rich variety of the latter, and by diminution in the iron oxide and increase in the alumina, laterite merges into bauxite. Between bauxite on the one hand and limonite on the other, all sorts of mixtures may occur.

In India laterite is reported as derived in part from rocks in place, as is the case with our Arkansas bauxite deposits, or as having been transported. The high-level laterites of India are said to bear a striking resemblance to bauxite. In examining the Vizagapatam hill tracts, C. S. Middlemiss[b] has paid especial attention to the high-level laterites of the Kalahandi State; and in the adjoining estate of Jeypore, he found the laterites occurring in beds 80 to 100 feet thick, but limited to a very well-marked plane surface from 3,500 to 4,000 feet above sea level. This surface, owing to its uniformity and extent, is thought to have originated as a plain of marine denudation on which the laterite was subsequently formed and which was afterwards modified by the ordinary erosive action of subaerial agencies. The area over which the ores are mainly developed stretches from the neighborhood of Korlapat in Kalahandi to the hills north of Doliamb on the Jeypore-Vizianagram road. Deposits of aluminous laterite have also been studied in the Madras Presidency, in the

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[a] Richards, Joseph W., Eng. and Min. Jour., June 8, 1907, p. 1083.
[b] India Geol. Survey Records, vol. 32, 1905, p. 143.

Central Provinces, and in Nalhati in Bengal. The result has been the definite determination of a number of instances in which the percentage of alumina is as high as in the high-grade deposits mined as sources of alumina in Europe and America; and the material appears to exist in quantities altogether out of proportion to present consumption.

The purity of the India deposits, their ready accessibility, and their association with flowing water are all points in favor of their being worked, should the demand for aluminum in the world at large justify such a course. At the present time, with present prices, a limited market, and the rate at which discoveries of new occurrences in the United States are being made, no bauxite has been found in India which in quantity and quality would compensate for the cost of export to American markets.

USES.

The chief uses of bauxite are (1) as raw material in the production of metallic aluminum. This is by far the most important use of the material. A large part of the entire output of the State of Arkansas has been devoted to this purpose, and the figures of production from this State have shown remarkable growth during the past few years.

(2) In the manufacture of aluminum salts. A large part of the Georgia-Alabama product is used for this purpose, owing to its relative freedom from oxide of iron.

(3) In the manufacture of artificial abrasives (alundum).

(4) In the manufacture of bauxite brick. This last use in refractory brick is of recent date. The bricks are of chief value in resisting the corrosive action of molten metal at high temperatures, and hence are applied in basic open-hearth steel furnaces, in furnaces for refining lead, in copper reverberatory furnaces, and in the linings of rotary Portland–cement kilns.

In the manufacture of the brick[a] the bauxite is first washed to remove free silica and then calcined at a temperature of 2,500° F. Very little or no shrinkage takes place below the temperature of 2,390°, hence 2,500° is about the lowest safe temperature that may be applied. The calcined material may be bonded with plastic fire clay, sodium silicate, or free lime, and the bricks, after drying, are burned in down-draft kilns at high temperatures, such treatment rendering them hard and tough. A 9 by 2½ by 4½ inch brick weighing 7½ pounds has been found to stand a crushing test of 10,000 pounds per square inch.

For open-hearth steel furnaces a high alumina and low silica brick is essential, and the purer the alumina used, the more satisfactory the results. The pisolites or small rounded concretions are found more satisfactory for this purpose, as they carry a higher content of alumina than the other grades of bauxite. This material is obtained by selecting, washing, and sifting the purest bauxite at the mine. The finer material containing the greater part of the silica passes through the sieve and is rejected. Recent tests have shown that bricks containing less than 12 per cent silica would be satisfactory, and that in open-hearth steel furnaces they withstand the corrosive action of the metal and basic slag as well as do magnesite bricks. The reason of this resistance may be due wholly or in part to the fact observed by Sir William Siemens that the bauxite, when subjected to the intense heat of the furnaces, is converted into a solid mass of emery, so hard as to be scarcely affected by steel tools and able to resist mechanical, calorific, and chemical action.

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[a] Aubrey, A. J., Mineral Industry, vol. 14, 1906, pp. 48–51.

As a lining in rotary Portland-cement kilns, bauxite brick are giving satisfaction. They are soft enough to allow a coat of the cement to stick to them and thus protect them, lengthening their term of use, and still not soft enough to allow any part of the bricks to be pulled away. Only a small part of the kiln need be lined with the brick, namely, the hot zone (10 to 12 feet in a 60-foot rotary kiln).

The most recent applications of bauxite brick are in the lining of lead-refining and copper reverberatory furnaces. During the process of lead refining the scum which rises to the surface is composed for the most part of basic oxides which attack the silica in ordinary fire-brick linings. The use of bauxite brick largely composed of basic oxide has reduced the tendency to reaction with consequent increased duration of life to the furnace lining. It has been estimated that bauxite brick last five to six times as long as ordinary siliceous fire brick.

ALUMINUM.

PRODUCTION AND CONSUMPTION.

Aluminum shared in the greatly increased demand, along with the other metals, copper, tin, lead, and zinc, during the first nine months of the year 1907, and the rise in the price of copper and tin no doubt served to widen the field of application of aluminum. Contrary to the general expectation and to numerous prophecies, the great increase in the domestic production did not materialize. This is to be accounted for to a certain extent—but probably not to the extent that is generally supposed—by the great falling off in the demand toward the close of the year, owing to the general business depression. In no branch of the aluminum industry has the influence of the general depression been felt more than in the manufacture of electric railway cars and motor cars. There has been an increasing demand for aluminum in the railway and motor car industries to which, owing to its lightness, the metal is well adapted.

At the beginning of the year the price of aluminum was steady and the demand good. During January, February, and March quotations on No. 1 ingots, containing over 99 per cent pure metal, were 36 cents per pound, and on No. 2 ingots, containing 90 per cent and more metal, they were 34 cents, with higher prices for small lots. At the end of April all pricelists of the metal were withdrawn from the market, and prices rose to 50 cents per pound and decreased but slightly until the panic of October. During December quotations ranged from 37 to 39 cents, with the trade very dull. About the middle of January, 1908, revised prices were issued, as follows: No. 1 ingots, 99 per cent pure, 33 cents per pound in ton lots; No. 2 ingots, 32 cents per pound—but little less than the prices which obtained just about a year before. At the time of closing this article (April 15, 1908) quotations on No. 1 ingots remain at 33 cents per pound in ton lots, with a base price on (1) rods and wire and (2) sheets of 38 cents and 40 cents, respectively.

The absolute increase in quantity of metal produced was less in 1907 than in either 1905 or 1906, and the percentage of increase was only about half that of 1905 and 1906.

The magnitude of the aluminum industry is shown by the following table, which gives the production since the beginning of the industry in 1883:

Production, in pounds, of aluminum in the United States, 1883–1907.

1883	83
1884	150
1885	283
1886	3,000
1887	18,000
1888	19,000
1889	47,468
1890	61,281
1891	150,000
1892	259,885
1893	333,629
1894	550,000
1895	920,000
1896	1,300,000
1897	4,000,000
1898	5,200,000
1899	6,500,000
1900	7,150,000
1901	7,150,000
1902	7,300,000
1903	7,500,000
1904	[a] 8,600,000
1905	[a] 11,347,000
1906	[a] 14,910,000
1907	[a] 17,211,000
Total	100,530,779

The value of the exports of aluminum and manufactures of aluminum of domestic production for the last four years has been as follows: 1907, $304,938; 1906, $364,251; 1905, $290,777; 1904, $166,876.

PROGRESS OF THE ALUMINUM INDUSTRY.

NEW INDUSTRIAL DEVELOPMENTS.

In August, 1888, the Pittsburg Reduction Company was organized, largely to manufacture aluminum under the patent to Charles M. Hall, and a factory in which to manufacture the metal was started in Pittsburg in November of that year. In 1890 the works were greatly enlarged, and in the following year they were removed to New Kensington, a suburb of Pittsburg, and in 1893 were again enlarged. In 1896 the production of pig aluminum at New Kensington was abandoned, since which time the works have been devoted to the manufacture of pig aluminum into more or less finished forms. Other works now operated by the company are located at Niagara Falls and Massena, St. Lawrence County, N. Y., and at Shawenegan Falls, Quebec, Canada, also at East St. Louis, Ill. During 1907 the capacity of the chemical plant at East St. Louis was greatly enlarged. The material from the Arkansas mines is washed and treated to free it from iron, silica, titanium oxide, and water at the East St. Louis plant.

The processes employed in the production of pure alumina have, so far as known, remained unchanged. The bauxite is first calcined to remove water and some oxygen. The subsequent treatment, invented by Hall, consists in treating the impure material mixed with the proper quantity of carbon in an electric furnace, whereby the more easily reducible iron, silicon, and titanium are extracted, leaving the alumina.

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[a] Consumption.

At New Kensington[a] the company has installed a continuous mill for rolling aluminum sheets, the only one of its kind in existence. This mill is said to have a larger capacity for rolling sheets than any mill in the country. The company is also making some additions to its power plant at this place, including one 400-horsepower Parker boiler and two 300-horsepower Westinghouse gas engines. With the completion of this work the power capacity of the New Kensington works will have been about doubled.

A new rolling and sheet mill has been also in course of construction at Niagara Falls,[b] and will be one of the largest and most complete sheet rolling mills in America. At Niagara Falls the lower plant, using power supplied from the canal of the Niagara Falls Power and Manufacturing Company, has been increased to use 45,000 horsepower divided into five units of 9,000 horsepower each

At Massena the company has purchased the entire plant of the St. Lawrence Power Company with its canal and power house of 40,000 horsepower capacity, and is preparing to dredge out the canal to double this capacity. A new power house for this enlarged capacity was started in 1907, and eight large water wheels to absorb the capacity of the first canal have been purchased for installation in the old power house.

The plans referred to in this report for the year 1906 as being formulated for extensive water power development and aluminum works on the Cumberland River near Corbin, Ky., have so far as known not yet materialized. Twenty thousand horsepower according to the plan proposed will first be developed, and most of this is to be used in the works.

APPLICATIONS OF ALUMINUM.

Recent progress in the applications of aluminum in the industries has been summarized by Joseph W. Richards.[c] The limitations of the metal are now well understood, and it is being employed to an increasing extent in those arts and industries where great mechanical strength in the metal employed is not essential. Its increasing use in motor cars and electric railway cars has already been mentioned. In the metallurgical industries the metal is used to clear molten iron and steel of all oxides before casting. The great drawback to its use for electrical purposes in the past has been the difficulty of obtaining it in a state of sufficient purity; but with care metal 99.9 per cent pure may now be made. In America its use in electric-power transmission schemes of magnitude is increasing, and a recent example of its use is the transmission of power from Niagara Falls 160 miles to Syracuse and 200 miles to Cleveland by the Niagara, Lockport and Ontario Power Company. The equipment to Syracuse contains 12,000 miles of heavy wire in 3 cables of 19 strands each. The voltage is 60,000.[d]

Its more recent applications in plating, soldering, and welding, and in the new alloys are given in detail by Richards in the articles cited. Still later inventions comprise a new method of producing the metal by electrolysis (H. S. Blackmore, United States patent No. 872,985, December 3, 1907), new solders, alloys, and a modification of the Goldschmidt process of reducing refractory oxides, invented by K. A. Kuehne (United States patent No. 878,210, February 4, 1908).

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[a] American Metal Market, January 3, 1907.

[b] See article by J. W. Richards in Eng. and Min. Jour., June 8, 1907.

[c] Eng. and Min. Jour., June 15, 1907, pp. 1147–1149; Mineral industry, vol. 15, 1907, pp. 21–27.

[d] Metal Industry, February, 1906.

ALUMINUM SALTS.

PRODUCTION.

There was a decrease of 33 per cent in the quantity of alum produced in 1907 as compared with the production of 1906. The quantity produced in 1906 showed an increase of 55 per cent over that in 1905, and the falling off in 1907 is to be explained in part at least by the excess of stock on hand. Such a history of events seems to have obtained also during the years 1903, 1904, and 1905.

The quantity of aluminum sulphate produced in 1907 increased about 20 per cent over that in 1906, and imports also showed a gain of 32 per cent in quantity, and of about 52 per cent in value.

The following table shows the production of alum and aluminum sulphate for the years 1903 to 1907:

Production and imports of aluminum salts into the United States, 1903–1907, in short tons.

Year.	Production.						Imports.[a]	
	Alum.			Aluminum sulphate.			Quantity.	Value.
	Quantity.	Value.	Per ton.	Quantity.	Value.	Per ton.		
1903	7,574	$210,910	$27.85	80,726	$1,614,520	$20.00	2,162	$107,948
1904	11,563	319,189	27.60	74,481	1,417,867	19.04	896	19,991
1905	10,114	289,716	28.65	93,917	1,660,515	17.67	1,282	26,242
1906	15,613	450,125	28.83	89,246	1,613,050	18.07	1,183	23,193
1907	10,404	361,900	34.78	106,821	2,008,046	18.80	1,562	35,191

[a] Includes alumina, aluminum hydrate, or refined bauxite, alum, alum cake, aluminum sulphate aluminous cake, and alum in crystals or ground.

NATURAL OCCURRENCE OF ALUMINUM SULPHATE.

An occurrence of scientific interest is the association of alunite ($K_2O.3Al_2O_3.4SO_3.6H_2O$) and gold in the Goldfield district of Nevada. F. L. Ransome[a] believes that the composition of the ores and the changes exhibited in the country rock point to hot ascending solutions as the agent which has produced the alunite. On some of the ore dumps the soluble sulphate is present in sufficient quantity to suggest its removal by leaching. Before undertaking such a step several factors must be considered, such as quantity of raw material, proximity to market, transportation facilities, freight rates, etc.

EXPERIMENTAL WORK ON ALUMINUM SALTS.

Recent experiments by Gawalowski[b] have proved the possibility of making a carbonate of aluminum. Under a pressure of eight atmospheres there is formed a polycarbonate which is completely soluble. Such pressure is found at moderate depths in the earth's crust, and this fact, together with the well-known power of carbon dioxide to act on the silicates and to convert them into carbonates, may have a possible bearing on the character of the hot spring deposition of bauxite advocated by Hayes in the Georgia-Alabama-Tennessee field.

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[a] Economic Geology, vol. 2, No. 7, 1907, p. 689.

[b] Chem. Centralblatt, pt. 1, 1906, p. 640.

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ANTIMONY.

By Frank L. Hess.

INTRODUCTION.

Beginning with high prices, the year 1907 soon developed a falling market, which continued through the year, so that there was little encouragement for American production, and mines that had been started were compelled to close down. In spite of this the output of ore in the United States during 1907 exceeded somewhat the production in 1906.

The antimony smelter built at Antimony, Utah, did not operate; but the smelters of Mathison & Co. on Staten Island, N. Y., and the allied Chapman smelter at Oakland, Cal., made antimony from both domestic and foreign ores. The Hoyt Metal Company of St. Louis, Mo., also used antimony ores in the manufacture of babbitt and other alloys.

The returns received by the United States Geological Survey indicate that 585 short tons of ore running about 60 per cent antimony, and worth about $77,300, were produced and sold in 1907, and that additional ore was mined and left on the dumps to await better prices.

Alaska.—Prospecting was continued on Manila Creek, about 15 miles north of Nome, and an antimony vein on which work was commenced in 1906 was cut by a tunnel at 315 feet from the portal.

In a recent report to the Survey Philip S. Smith, who visited these deposits, says:[a]

> The main work accomplished has been the driving of a crosscut adit which successfully located the vein. This adit was 315 feet long, and the vein where intersected was 3 feet wide. It is reported, however, that the amount of antimony was materially less than in the surface exposures, but that the gold tenor had fortunately increased. The quartz is described as being white and compact, but with a small amount of metallic minerals visible. If the decrease in the amount of antimony present in the ore is as marked in the next lower level as it has been from the surface to the adit level the value of the mine is likely to be determined by the gold content of the ore, with very subordinate values in antimony.
>
> The Manila Creek property is the only one in the district that has shipped any antimony ore, but there are several places in the same general region where stibnite has been found. On the east side of Nome River, near the head of the Osborn Creek drainage basin, three prospectors at the close of the season found promising indications of an antimony lode. The lead is

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[a] Investigations of the mineral deposits of Seward Peninsula; Bull. U. S. Geol. Survey No. 345, 1908, pp. 244–245.

reported to be rather flat lying and is much contorted, the ore occurring in lenses and kidneys. A piece of ore 6 inches wide, 8 inches thick, and a foot long from this vein was examined and found to consist of almost pure stibnite. The ore, in addition to antimony, carries more or less gold. Near the gold lode on Goldbottom Creek also some auriferous antimony ore has been reported, but the prospect was not visited by members of the Survey. On Last Chance Creek a vein which is said to be 5 feet wide has been discovered, but exploration has not proceeded far enough to show the value of the property. Picked samples, however, are reported to yield high assays in both gold and antimony. Near the mouth of Goldbottom Creek on Snake River some stibnite has been found, and it was proposed to ship some of the ore, but it is not known whether this was done or not.

Arkansas.—The antimony deposits near Gilliam, Sevier County, in the western part of the State, were not operated. They were visited by the writer, who described them in Bulletin 340 of the United States Geological Survey.

California.—No antimony ore is known to have been produced in the State during 1907, but some work was done upon the New Mohawk claim in the Graniteville district, Nevada County.

Idaho.—The Stanley Consolidated Mining and Milling Company is mining antimony ore in connection with gold ore at Burke, in the La Lande district, Shoshone County. The tunnels aggregate about 3,500 feet in length. Antimony ore was shipped during the year, and a considerable amount of both antimony and gold ores remained on the dumps.

Nevada.—Antimony ore was shipped by Smith & Green, who operate a mine in Bullion Canyon, 15 miles south of Mill City. Most of the ore went to Oakland, but two carloads were shipped to Belgium early in 1907. Mr. Green erected a small reverberatory furnace, and by using sage brush as fuel was able to produce a regulus containing from 80 to 90 per cent of antimony.

The Antimony King Mining Company has a mine near Austin, developed by a shaft 230 feet deep, and another at Battle Mountain, with two shafts 90 and 65 feet deep, respectively, and a tunnel 140 feet long. The ore was shipped to San Francisco brokers.

Thirty-five miles northeast of Lovelock some development work has been done on the Antimony Queen claim.

Antimony claims have been located in the Black Knob district, near Lovelock, but no output was made during 1907.

Oregon.—Considerable work was done by the Martin Creek Mining Company on its claims in the Bohemian mining district, Douglas County, 16 miles from Red Bridge on the Oregon and Southeastern Railroad. The mine is reached by 12 miles of wagon road and 4 miles of trail. They have drifted 65 feet along the vein and are driving a tunnel to cut the vein 110 feet deeper. No ore has yet been shipped.

Utah.—A smelter was finished by the Utah Antimony Company at Antimony, Garfield County, in which a sublimation process for the production of antimony oxide from the ore is to be used. Metal is to be produced from the oxide. By the time the works were finished prices had declined so much that nothing more was done. The deposits were visited by G. B. Richardson, of the United States Geological Survey, who described them in Bulletin 340.

Some antimony ore was shipped from Antimony to the Chapman smelter at Oakland by leasers upon the property of the Utah Antimony Company.

Washington.—The Lucky Knock Mining Company operated its mines in the Galena district, at Loomis, Okanogan County, and produced both ore rich enough for shipment and also other ore which requires concentrating. Most of the production was left on the dump.

As usual, the larger portion of the antimony produced in the United States was that contained in antimonial lead and sold by the smelters in that form. As this alloy is extensively used in type metal, babbitt metal, coffin trimmings, and similar wares there is no need of separating the two metals.

PRODUCTION.

The production of antimony in the United States since 1901 has been as follows:

Production of antimony in the United States, 1901–1907, in short tons.

Year.	Contained in antimonial lead.		Produced from foreign and domestic ores.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	2,235	$457,150	414	$84,870	2,649	$542,020
1902	2,904	505,340	[a] 657	129,166	3,561	634,506
1903	2,558	445,092	[a] 570	103,341	3,128	548,433
1904	2,571	443,598	[b] 486	[c] 61,926	3,057	505,524
1905	2,747	588,354	493	117,433	3,240	705,787
1906	1,362	[c] 544,800	[d] 404	58,149	1,766	602,949
1907	1,671	[e] 544,746	[d] 351	77,300	2,022	622,046

[a] Exclusive of foreign ores imported and reexported.

[b] Estimated from the average content of the ore.

[c] Estimated from the prices current for the year.

[d] Figured as 60 per cent of domestic ores only; direct figures from the smelters could not be obtained.

[e] Estimated, using 16.3 cents as the average price for the year.

IMPORTS.

The imports of antimony in the form of metal, regulus, ore, and salts exceeded in value even those of 1906, up to that time the greatest recorded. The importations rose in value from $1,616,381 in 1906 to $1,686,802 in 1907.

Antimony, antimony ore, and salts of antimony imported and entered for consumption in the United States, 1901–1907, in pounds.

Year.	Metal and regulus.		Crude antimony and ore.		Salts of antimony.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
1901	3,674,923	$255,346	1,731,956	$24,256	(a)	(a)	$279,602
1902	5,388,739	333,601	3,129,069	62,968	(a)	(a)	396,569
1903	4,694,309	260,144	2,714,617	54,316	916,468	$66,469	380,929
1904	4,268,045	248,726	2,488,518	50,414	981,026	70,668	369,808
1905	4,941,247	431,228	1,970,788	53,026	1,010,228	80,130	564,384
1906	10,305,734	1,391,289	1,972,658	125,841	764,070	99,251	1,616,279
1907	9,600,901	1,407,861	2,771,387	180,903	682,192	98,038	1,686,802

[a] The imports of antimony salts and their values for these years are not obtainable.

The consumption of antimony and antimony salts in 1907, as shown by the addition of the values of production and of imports, amounted to $2,308,848.

PRICES.

The year 1907 began with antimony at the abnormally high prices which obtained during the larger part of 1906. In January, 1907, large lots sold at 26 cents per pound, and the average price for the month was close to that figure. However, the price gradually dropped until May. During June it dropped much more rapidly, and the rapid decline kept on during July, so that in August the average price was only about 11 cents per pound. Prices continued to fall, so that the average price for December was about 9.5 cents.

The average price for the year, taking the quotations furnished upon the market day nearest to the 1st and 15th of each month by the American Metal Market, was about 16.3 cents per pound.

TUNGSTEN, NICKEL, COBALT, TITANIUM, ETC.

By Frank L. Hess.

TUNGSTEN.

The principal tungsten minerals are wolframite, a tungstate of iron and manganese, and scheelite, a tungstate of calcium. Both minerals, like the tin ores, generally occur in quartz veins cutting rocks containing much silica, such as granite and rhyolite. Sometimes they penetrate formations lying adjacent to these igneous rocks. Apparent exceptions to this rule are found, as for instance, in the Victorio district, 18 miles west of Deming, N. Mex., where hübnerite and a small amount of scheelite occur with pyrite and lead minerals in a vein cutting limestone; and at Nome, Alaska, where scheelite is found in the gold placers in a region of schists, several miles from the nearest granite outcrops. However, in general, search for tungsten may be expected to be most successful in districts of granitic rocks.

PRODUCTION OF TUNGSTEN.

During the first nine months of 1907 the business in tungsten ores and products was brisk, prices were high, ranging from $9 to $14 per unit for tungsten ore carrying 60 per cent or over of tungsten trioxide, and there was a large increase in the production both in this country and abroad. On the 1st of October one of the large dealers stopped buying, and others followed, though some buying continued at low prices, $5 per unit being an ordinary offering during the latter part of the year.

The demand during the first part of the year was much greater than that of 1906, and was due mostly to the use of tungsten in tool steel. Under the stronger demand, with a consequent rise in prices, prospecting and mining were both actively prosecuted, so that the output of the United States was increased from a total of 928 short tons of concentrates carrying 60 per cent tungsten trioxide in 1906 to 1,640 short tons in 1907, while the value rose from $348,867 to $890,048. Colorado, the tungsten mines of which are all located in Boulder County, again led in production with 1,146 tons of wolframite approaching ferberite in composition, valued at $573,642.74. California was the second State in order of production, while smaller amounts were produced in Montana, Washington, Nevada, Arizona, and probably in New Mexico. The output from California and most of that from Montana was in the form of scheelite, of which a total of

414 short tons was mined. No ore is known to have been produced in South Dakota, although much prospecting and some development work was carried on.

The tungsten-mining industry of Boulder County, Colo., is largely in the hands of a few companies, several of which work their properties by leasing. It has been found that the ores may often be gotten out more cheaply in this manner than by working from a large central plant. It is probable, however, that in the long run the leasing system will not be so good for the property as operation by the owners, for systematic development can not be accomplished in this way, and the richer ore only will be taken out. Only a few of the companies have concentration plants, and these companies either buy the ores produced by smaller operators or operate their plants as custom mills. The losses in milling are serious, and efforts are being made to reduce them. The ores ordinarily mined are said to require from 20 to 30 tons to produce 1 ton of concentrates carrying 60 per cent tungsten trioxide. Richer ores than this are mined, but they are the exception. The larger companies find it impossible as a rule to produce tungsten ore profitably at $5 or less per unit, so that the product for 1908 will undoubtedly be less than for 1907.

The largest individual American producer of tungsten ores, and probably the largest in the world, during 1907, was the Cardinal Company, at Boulder, Colo. Other companies producing at Boulder are the Colorado Tungsten Corporation, the Wolf Tongue Mining Company, the Lincoln Mining, Milling and Improvement Company, the Lehigh Tungsten Mining and Milling Company, and the Crescent Wolfram Estates. At Primos the Stein-Boericke Mining Company, connected with the Primos Chemical Company, Primos, Pa., are large producers. At Nederland, Philip Bauer & Co., the Tungsten Mining, Milling and Exploration Company, the Crucible Steel Mining Company, James A. Francis, Voightlander & Flood, and the Tungsten Mines Company; at Magnolia, the Redemption Mines Company, and at Sugar Loaf, F. J. Burdett, are operating tungsten mines. Some of the mines are worked down to a depth of about 400 feet.

In California by far the largest production was made by the Atolia Mining Company, at Atolia, San Bernardino County, 5 miles south of Randsburg. Other operators in the vicinity are Charles Wetherbee & Company, William Greenwood, C. G. Illingworth, and W. A. Wickard. Were water more plentiful the Sidney mine of the Stringer district near Randsburg would also probably become a producer. Scheelite occurs with gold at this mine. Some production was also made by the Tehachapi Mining Company at Paris, Kern County, on whose property there is a shaft 275 feet deep; a tunnel is to intersect the vein at a depth of 500 feet. Wolframite has been found in the Ivanpah and New York Mountains, San Bernardino County; near Nipton close to the Nevada line, and also near Raymond, Madera County; but there has so far been no production of this mineral in the State.

The United Golden Chest Mining and Milling Company at Murray and the Golden Winnie Tungsten Mining and Milling Company, at Wallace, Idaho, are developing scheelite deposits. The former has driven about 3,000 feet of tunnels in working the gold deposits with which the scheelite occurs, and the latter has a 400-foot tunnel.

In Wyoming the Jackson Hole Mining Company in the Jackson Hole region, near Elk, reports that wolframite occurs in the gravels which they are working for gold.

In Montana, hübnerite was produced at the Birdie mine, 4 miles east of Butte. The Birdie has been worked for a silver mine, and the tungsten ore is said to occur in a shoot at the end of a silver-bearing vein. The shoot is reached by a 400-foot tunnel at a depth of between 250 and 300 feet. At Jardine, Park County, near Yellowstone Park, the Kimberly-Montana Gold Mining Company is the principal producer of scheelite, though the mineral occurs on other properties in the vicinity. The scheelite is of a peculiar glassy yellowish brown in a dark gray quartz, which is also glassy in appearance. The mine has been operated as a gold mine, and the output of scheelite was incidental. It is reported that as high as 80 tons have been mined from one pocket. The ore is hand picked and of good quality.

In Washington wolframite was produced in Stevens County by the Tungsten Mining Company in the Springdale district, and also at Deer Trail from a property which is understood to be in litigation.

In Arizona hübnerite was produced by Williams and Pittman, 80 miles south of Kingman and 12 miles east of Big Sandy River in the Aquerra Range, near Owens; and by T. Clemons, George S. Mulkey, and P. M. Sebering at Dragoon. At the former place veins are worked; at the latter the ore was obtained from placers.

The production of tungsten ores in the United States since 1900 has been as follows:

Production of concentrated tungsten ores in the United States, 1900–1907, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	46	$11,040	1904	740	$184,000
1901	179	27,720	1905	803	268,676
1902	184	34,040	1906	928	348,867
1903	292	43,639	1907	1,640	890,048

Ores were bought by United States dealers and manufacturers from a number of foreign countries during the year, but the figures representing the importations are not available to this Bureau, as they were not segregated by the customs service. Twenty-nine tons of ferrotungsten, valued at $34,417, were imported. There were no exports.

WORLD'S PRODUCTION OF TUNGSTEN.

During 1907 the production of tungsten increased largely in a number of countries, and of these the United States showed the most notable rise in its output. The production of Australia (including Tasmania), amounting to 1,643 tons, was the only one which exceeded or rivaled that of this country. The output of South Africa, New South Wales, and the Northern Territory of Australia, showed especially notable increases. Spain, New Zealand, Austria, and Germany, whose combined production during 1906 was 463 short tons, have not made public their figures of production for 1907, and it seems probable that there will be, in each case, an increase. The latest Bolivian figures obtainable, 75 tons, are those for 1905. It is said that about 507 short tons of wolframite were shipped under the name of iron ore from Argentina during 1907, and although no official confirmation can be obtained, the figures are considered reliable. This shipment being accepted, the world's total production in 1907 was probably about 5,800 short tons.

The world's output of tungsten ores, reduced as far as possible to a basis of 60 per cent tungsten trioxide for 1905, 1906, and 1907, is tabulated below. Figures in italics are the same as those for the last year the output of which is known, and are used where the actual production can not be obtained.

The world's production of tungsten ore during 1907, by countries, estimated in short tons of concentrates containing 60 per cent of tungsten trioxide.

Country.	1905.	1906.	1907.	Country.	1905.	1906.	1907.
United States	803	928	1,640	Billiton [j]	....	....	41
England [a]	193	304	361	Northern Territory (Australia)	71	[k] 114	443
France	28	[b] 20	*20*	Queensland [l]	1,582	865	703
Portugal	320	[c] 629	702	New South Wales [m]	251	270	451
Spain	413	[d] 222	*222*	Tasmania [n]	36	22	46
Italy [e]	36	28	*28*	New Zealand [o]	64	121	*121*
German Empire	42	[f] 57	*57*	South Africa [p]	....	9	211
Austria [g]	65	63	*63*	Bolivia	75	*75*	*75*
Siam [h]	....	....	10	Argentina [q]	....	[q] 326	507
Federated Malay States [i]	....	151	89				
Singkep [j]	....	....	1	Total	3,979	4,204	5,791

[a] Mines and quarries, general report and statistics for 1906, Home Office, London, 1908, pt. 4, p. 124, and pt. 1, 1908, p. 10. Percentage of tungstic trioxide contained is unknown.

[b] Statistique de l'industrie minérale et des appareils à vapeur en France et en Algérie pour l'année 1906, Paris, 1907, p. 32. Percentage of WO_3 contained in ores unknown.

[c] Letter of J. F. N. Delgado, Director Roy. Geol. Survey of Portugal, Feb. 27, 1908.

[d] Estadistica minera de España, 1906, Madrid, 1907, p. 54. The apparent lesser output of 1906 below 1905 is due to the reduction of the ores produced in 1906 to a 60 per cent basis, which was not done for the 1905 output. On the basis of the prices given these quantities have been reduced to 60 per cent on the supposition that the production in Cordoba, Coruna, and Pontevedra was all of about the same content, 25 per cent; Orense and Salamanca, 40 per cent, and Caceres, 60 per cent. Figures for 1907 not available.

[e] Rivista del servizio minerario nel 1906, Roma, 1907, p. 242. Percentage of ores unknown. Production for 1907 not obtainable.

[f] Figures for Saxony only. Jahrbuch für das Berg- und Hüttenwesen im Königreiche Sachsen, vom Jahre 1906, Freiberg, 1907, pp. 39–40. Percentage of tungstic trioxide in ores not given. Figures for 1907 not obtainable.

[g] Statistisches Jahrbuch des k. k. Ackerbau-Ministeriums fur das Jahr 1906, Wien, 1907, p. 186. Percentage of tungsten trioxide not given. Figures for 1907 unobtainable. The figures given show a decrease of 15 met. zentners (less than a ton) from the output of 1905.

[h] Letter from John H. Heyl, Act. Director Royal Dept. of Mines and Geology, Siam, dated March 11, 1908. Percentage of tungstic trioxide unobtainable.

[i] Letter from J. B. Scrivenor, Government Geologist, Federated Malay States, dated Feb. 24, 1908. The output was from the States of Perak, Selangor, and Negri Sembilan. The percentage of tungstic trioxide is unknown.

[j] Min. Jour., London, vol. 83, 1908, p. 378. The ore from Billiton was mixed with cassiterite. The tungsten content is unknown.

[k] Min. Jour., London, vol. 83, 1908, p. 622. During 1907, 1,582 long tons of tungsten ore, valued at £11,296, were exported. This amounts to $31.02 per short ton, from which it is concluded that the ores could not, at the outside, have carried over 15 per cent tungstic trioxide, so that the figures in the table are only one-fourth of the tonnage exported.

[l] Queensland Govt. Min. Jour., vol. 9, 1908, p. 124. Of these ores, 225 long tons were scheelite, 615.2 tons wolframite, and 10.5 tons were mixed tungsten and bismuth ores. The whole was valued at £91,305. The tungsten content of the ores is unknown, but, from the value, was evidently high.

[m] Letter from E. F. Pittman, Under Secy., Dept. of Mines, New South Wales, dated March 24, 1908. Of this total, 219.5 long tons, valued at £23,781, were scheelite, and 231.6 tons, valued at £26,235, were wolframite. Although the percentage of tungstic trioxide contained is not stated, as in Queensland, the value given shows that it was probably high.

[n] Progress of the mineral industry for quarters ending June 30 and December 31, 1907, Hobart, 1907 and 1908. Percentage of tungsten not given, but value (£4,411) is high.

[o] Papers and reports relating to minerals and mining, Wellington, 1907, p. 47. Figures for 1907 not available. The output was all scheelite; 94.35 tons were valued at £5,520.

[p] Second annual statement of the trade and shipping of the colonies and territories forming the South African Customs Union, 1907, Cape Town, 1908, Ann. No. 35, Con. 41. The total value is given as £4,745, or only about $27.33 per ton, so that, as in the case of Northern Territory, the figures have been divided by four to reduce to a 60 per cent basis. The report does not state whether the short or long ton is used, but it is taken that the short ton is meant, as this is used by the Rhodesian Chamber of Mines, and much of the ore (230 tons) is from Rhodesia. The figure for 1906 is taken from the first annual report.

[q] Mines and quarries, general report and statistics for 1906, Home Office, London, 1908, p. 332. Percentage of tungstic trioxide contained is unknown, but it is reported that the ores are hand picked and of high grade.

PROBABLE FUTURE PRODUCTION OF TUNGSTEN.

Concerning the probable future output, generalizations only can be made. Tungsten deposits are usually "pockety;" that is, the ores occur in lenticular masses or shoots in veins. Those occurring at the surface are often quickly and easily mined, and it may then require all of the profits made from the first-exposed ore body to locate another one. However, the veins carrying tungsten minerals appear to be of deep-seated origin, and, generally speaking, other ore bodies will probably be found in depth, though just as in mining for other minerals the expense of search may be out of proportion to the size of the pay shoots.

Queensland is a country in which the deposits exposed on the surface have been largely exploited, and the production has, in the face of rising prices, fallen greatly since 1905. In England, Spain, Portugal, Austria, Germany, Bolivia, and the Dutch East Indies, tungsten and tin ores occur together, and the working costs are thus lowered. Magnetic separators are increasing the production of tungsten ores in England and are responsible for nearly the whole output of that country.

The occurrence of tungsten is wide, but the individual deposits can hardly be said to be large. In times of high prices there are many deposits which can be worked that will be idle at lower prices, and considering the great fall in value of tungsten ores it seems probable that the output for 1908 will be much less than that of 1907.

TESTS FOR TUNGSTEN MINERALS.

Materials required for tests.—Owing to the number of inquiries received concerning the identification of tungsten ores, it seems advisable to give a description of the tungsten minerals and of simple tests for them which have been found reliable by the writer.

The tungsten minerals of commercial importance are scheelite and wolframite (including hübnerite). The tests which are given hereafter for these minerals are such as can be made by any prospector who can obtain hydrochloric (muriatic) acid, a test tube, a teacup, or a water glass, and a little tinfoil, a piece of zinc, a bit of solder, or even a scrap from an ordinary tin can. A few test tubes and an alcohol lamp are not expensive or hard to carry, and add much to the convenience of testing. In testing the minerals, should an alcohol lamp or similar heating device not be available, it is well to heat the cup or glass used by placing it on the back of a stove or filling with hot water before using, to get prompt and energetic action from the acid. A candle will serve the purpose, but it blackens the vessel.

In testing for tungsten, unless the suspected mineral is present in quantity, the material should be concentrated by panning or careful selection. Owing to the high specific gravity of the minerals, they are easily concentrated by panning.

Scheelite.—Scheelite is calcium tungstate, a combination of lime and tungsten trioxide. In appearance it varies from an almost glassy white to a dull brown or yellow and is occasionally of a slight greenish tinge. However, it is always of a stony appearance, some specimens resembling coarse marble in structure. In places, though rarely, it shows its crystal form, which is tetragonal. It has a specific gravity of 6, or about twice that of limestone or quartz, and its weight at once attracts attention. It is somewhat softer than limestone and is easily scratched with a knife. The only other minerals which are liable to be confused with it are barite, which is softer and not so heavy, having a specific gravity of 4 to 4.5, and quartz, which has a comparatively low specific gravity (2.65) and can not be scratched with a knife. Scheelite has an almost greasy, lustrous appearance when broken; the appearance of barite is often dull, and quartz has a more splintery or conchoidal fracture.

To test scheelite place a portion of the powdered mineral the size of a pea in a test tube or a cup and cover with a teaspoonful of hydrochloric acid. Upon boiling a few minutes or, if not heated, allowing to stand a considerable time, tungsten trioxide (WO_3), a bright yellow powder, is formed. Upon the addition of metallic tin or zinc the yellow powder is reduced to a lower oxide which is of a characteristic beautiful blue color, and later to still lower oxides of other colors.

With *zinc* the solution first turns blue, then wine colored, and later brown. When the reduction takes place very quickly the blue color of the solution may not be seen at all, the first color to appear being a reddish lilac, quickly turning to brown.

With *tin*, it turns successively blue, lilac, wine colored, and more slowly to brown. The wine color may last for hours. Tinfoil, which is ordinarily composed largely of tin with varying amounts of lead, may be used. In the reduction with tin the solution nearest the tin will often have a lilac or wine color, while a short distance away the solution will be a fine blue.

With either zinc or tin the powdered mineral itself will be colored blue, even though the solution may be of a different color. When treated with acid several minutes should be allowed to elapse before introducing zinc or tin; otherwise the yellow oxide may not be formed in sufficient amount to give a good reaction, and neither the blue nor the pink color will be seen, but the solution will be a yellowish brown. However, a blue sediment will form in the bottom of the vessel. If one part of hydrochloric acid diluted with two parts of water be used, tin gives to the solution a blue color which lasts a considerable time.

Sulphuric acid diluted with two or three parts of water to one of acid may be used instead of hydrochloric acid, and seems to be the more active of the two in changing scheelite to tungsten trioxide. It is slower than hydrochloric acid in reducing the yellow oxide to the blue oxide upon the addition of zinc and needs more heating, but gives the same blue color, which is more lasting and may still show after standing twenty-four hours.

With tin, sulphuric acid acts still more slowly and requires considerable heating, but gives the same lasting blue color. Nitric acid gives the yellow tungsten trioxide, but will not give the further reactions.

Wolframite.—Wolframite is an iron manganese tungstate, commonly dark brown to black in color and with submetallic luster. It has a good cleavage, so that when broken it will cleave into thin plates. Sometimes, however, it forms fine-grained aggregates in which the cleavage is not readily apparent. In composition it ranges from hübnerite, practically a pure manganese tungstate, through various mixtures of manganese and iron tungstate toward ferberite, theoretically a pure iron tungstate. It is doubtful whether this latter form really exists in nature, as all known analyses show more or less manganese. All of the manganese tungstates contain some iron, but they approach the theoretical composition more closely than does ferberite. Hübnerite is rarely, if ever, found in well-formed crystals, though one or two faces are often found. On the flat cleavage faces it has a characteristic, subtranslucent, almost resiny appearance. The specific gravity is from 7.2 to 7.5. It has a hardness of 5 to 5.5, and when scratched it gives a light-yellow to seal-brown streak. When the mineral contains more iron, approaching ferberite in composition, the color of the mineral and its streak become black, and small, chisel-shaped crystal forms frequently appear. Hübnerite is the ordinary form found in Arizona and Nevada, as at Dragoon and Arivaca, Ariz., and at Round Mountain, Nev. The hübnerite found in the Birdie mine at Butte, Mont., is much lighter colored and has in thin blades an almost yellow color. The wolframite mined in Boulder County, Colo., and frequently referred to as ferberite, which in composition it closely approaches, is in small grains in brecciated vein matter. Many specimens show crystal form. Wolframite found in South Dakota contains more manganese than that found in Colorado and the appearance varies greatly. Some of it is in masses of fine, granular structure, with a brown coating wherever crushed, and has but little in common with the appearance of wolframite from other portions of the country. It is in places a mass of small, imperfect crystals and specularite is sometimes mistaken for it.

In testing wolframite the mineral should be finely powdered, then heated or boiled with hydrochloric acid for from ten to twenty minutes before treatment with zinc or tin. Otherwise, owing to the difficulty of digestion in acid, no reaction will be seen. The same phenomena will appear upon treatment with zinc or tin as in the case of scheelite.

The mineral may be tested much more certainly and easily by powdering a small portion, mixing intimately, and fusing with ordinary baking soda in an iron spoon or on a piece of sheet iron inserted in the end of a split stick. If well fused, the presence of manganese will be shown by the green color of the mass. Even should the fire not be hot enough for entire fusion, the test will be made much easier by the mere caking of the material. After thus heating with soda the mass is treated with acid and reduced with zinc or tin, as described under scheelite, and gives the same reactions.

Sulphuric acid acts more slowly and requires more heating than hydrochloric acid, but gives to the solution the same blue color, though it is much more lasting.

Nitric acid causes the formation of yellow tungsten trioxide, but does not give the blue color or other colors of the lower oxides.

No elements which interfere with the tests suggested are known to occur with tungsten ores.

NICKEL AND COBALT.

A certain amount of nickel, cobalt, and copper sulphides occur with the lead ores in southeastern Missouri, and a considerable saving of these concentrates was made by the Hudson Valley Lead

Company and the North American Lead Company, of Fredericktown. The latter company operates a smelter for reducing the metals. The only other production of these ores was made by the Standard Consolidated Mining Company, of Prairie City, in eastern central Grant County, Oreg. However, like that of tin, the total output of nickel and cobalt in the United States was insignificant when compared with either the world's output or the amount used in the country. Owing to the fact that the total output can not be given without allowing the individual productions to be known, the figures will not be printed.

PRODUCTION IN FOREIGN COUNTRIES.

As in former years, the principal producing foreign mines were those at Sudbury, Ontario, and in New Caledonia, with mines producing smaller amounts in Norway, Germany, Peru, and Mexico.

CANADA.

The Ontario production in 1907, though somewhat less than in 1906, was larger than the combined production of the other deposits of the world. The production of nickel in ore and matte in Ontario, since 1901, has been as follows:

Production of nickel in Ontario, 1901–1907, in short tons.[a]

Year.	Ore smelted.	Matte obtained.	Nickel in matte.
1901	270,380	45,134	4,441
1902	233,338	24,691	347
1903	209,030	13,832	6,253
1904	118,470	8,924	5,274
1905	257,421	17,388	9,438
1906	340,059	20,364	10,745
1907	359,076	22,041	10,095

[a] From figures published by the Department of Mines, Ottawa. The 1907 figures are from preliminary report on the mineral production of Canada in 1907, by John McLeish, Ottawa, 1908, p. 11.

The matte was practically all shipped to other countries for refining, 1,259 tons going to England and 8,429 tons coming to the United States.

NEW CALEDONIA.

The Caledonian operators feel very severely the competition of the Canadian mines, and the nickel ore exports show a decrease for 1907. The cobalt exports show an increase, but this is said to be due to the shipment of ore mined in 1906.

The ore exported from New Caledonia during the last five years is shown in the following table:

Quantity of nickel and cobalt ore shipped from New Caledonia, 1903–1907, in short tons.[a]

Year.	Nickel ore.	Cobalt ore.
1903	80,865	9,140
1904	108,747	9,881
1905	138,106	8,729
1906	144,057	3,070
1907	112,112	4,345

[a] Quoted in Min. Jour. (London), vol. 83, 1908, p. 529, from a British consular report by T. Manning.

The metallic content of the ores for 1905 is said to have been about 7¼ per cent, and for 1906, 6 per cent. For other years it is unknown. None of these ores came to the United States.

IMPORTS OF NICKEL AND COBALT OXIDE.

The imports for consumption of nickel into the United States since 1902, inclusive, as reported by the Bureau of Statistics, have been as follows:

Imports of nickel for consumption into the United States, 1902–1907.

Year.	Nickel, nickel ore and matte, nickel oxide, alloys of nickel with copper, etc.		Value of manufactured articles of nickel.	Total value.
	Pounds.	Value.		
1902	33,942,710	$1,407,521	$30,128	$1,437,649
1903	36,217,985	1,456,605	37,284	1,493,889
1904	19,739,315	1,118,541	2,950	1,121,491
1905	31,072,206	1,958,840	3,291	1,962,131
1906	34,159,440	1,893,404	8,963	1,902,367
1907	18,598,638	2,233,867	9,159	2,243,026

The imports of cobalt ore, cobalt oxide, and zaffer since 1901 have been as follows:

Cobalt oxide, ore, and zaffer imported into the United States for consumption, 1901–1907, in pounds.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1901	71,969	$134,208	1905	70,048	$139,377
1902	79,984	151,115	1906	41,084	83,167
1903	73,350	145,264	1907	48,013	74,849
1904	42,354	86,925			

The imports for 1906 included 12,850 pounds of ore and zaffer, those for 1907, 5,219 pounds valued at $1,821.

EXPORTS OF NICKEL.

The exports of nickel from the United States since 1901 have been as follows:

Exports of nickel, nickel oxide and matte from the United States, 1901–1907, in pounds.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1901	5,869,655	$1,521,291	1905	9,550,918	$2,894,700
1902	3,228,607	924,579	1906	10,620,410	3,493,643
1903	2,414,499	703,550	1907	8,772,578	2,845,663
1904	7,519,206	2,130,933			

TITANIUM.

The only American production of titanium ore during 1907 was made by the American Rutile Company from their rutile deposits at Roseland, near Arrington, Nelson County, Va. Their output was considerably increased over that of 1906.

These deposits are in great pegmatitic dikes, which vary considerably in composition but generally consist mostly of orthoclase and albite feldspars and blue quartz with rutile in greatly differing proportions. At places there is much hornblende; more rarely the rock contains much apatite. The dikes have been crushed in places to a schist, and the rutile, which probably showed more or less crystal form, has in the least disturbed portions been mashed into wavy lines of fragments. At certain points the rutile has segregated in considerable quantity and forms from 5 to perhaps 35 per cent of the mass. The American Rutile Company is working areas containing such segregations.

On the property of this company a dike of apatite and ilmenite, 3 or 4 inches thick, cuts the pegmatite. At other places much larger dikes of this composition occur, in some places carrying actinolite. This apatite-ilmenite rock has been named nelsonite by Dr. Thomas L. Watson.[a] At another place on the property of the company there is an outcrop of a dike a few feet wide composed of apatite and rutile. At a place 5 or 6 miles away, the General Electric Company has been prospecting upon a similar dike which ranges in width up to 5 feet and probably carries 50 per cent of rutile. The nelsonite and the rutile-apatite dikes are apparently phases of the same rock.

During the year a new titanium mineral, named benitoite, was discovered upon the headwaters of the San Benito River in San Benito County, Cal.[b] The mineral has no importance as a source of titanium, but is an interesting new compound of titanium, barium, and silica. It is blue in color, of a different shade from sapphire, and is somewhat softer than quartz. It is said to have a greater refraction, and so to be more brilliant than sapphire when cut.

Much activity was shown in experimenting with ferrotitanium during the year, and the American Titanium Alloys Company at Niagara Falls, in cooperation with various railroad companies, caused several lots of rails to be made in which ferrotitanium was used. These rails are being tested by actual use, and so far the results are said to be encouraging. The use of titanium in gray iron seems to give much promise, while less effect is seen in white iron. The favorable action of titanium seems to be entirely that of a scavenger, combining with and removing in the slag the oxygen and nitrogen contained in the iron or steel. It is said that this allows the making of steel rails with a much higher carbon content, thus making a harder rail, while retaining the toughness of the mild steel. However, the experiments now under way will go far toward definitely establishing these points. The tendency is to use ferrotitanium with a low titanium content, and 10 per cent titanium, low in carbon, seems to be called for most often. Only one-tenth of 1 per cent of titanium is needed to treat steel or iron. The company is also engaged in experiments with cuprotitanium. The Primos Chemical Company, of Primos, Pa., is also engaged in experiments with ferrotitanium and other titanium alloys.

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[a] Mineral Resources of Virginia, Lynchburg, 1907, pp. 300-301. During the year Dr. Watson also published an article entitled "Occurrence of rutile in Virginia," in Economic Geology, vol. 2, 1907, pp. 493-504.

[b] Louderback, G. D., Benitoite, a new California gem mineral, with chemical analyses by Walter C. Blasdale: Bull. Dept. Geol. Univ. California, vol 5, 1907, pp. 149-153.

Arnold, Ralph, Notes on the occurrence of the recently described gem mineral, benitoite: Science, vol. 27, new series 1908, pp. 312-314.

Titanium carbide and ferrotitanium for arc lighting have had much attention during the year, and this field apparently offers a large use for rutile.

A considerable number of patents have been issued for the use of titanium in electric lighting, going back to 1878, when Thomas A. Edison took out a patent in England for the use of titanium oxide (rutile) in arc lights. Combinations of titanium oxide and carbon are used in a number of these patents.

Little has been made public of progress in using titanium as a filament in incandescent electric lamps, but it is known that several manufacturers are working upon it.

Besides the production of rutile in the United States, Norway produced 56.5 tons of almost pure rutile and 10 tons containing 45 to 50 per cent of rutile. The Norwegian rutile comes from Kragerö, in the southern part of the country, on the coast northeast of Kristiansand.

In South Australia, at Para Wira, 6 tons of "matrix,"[a] valued at £38, and at Talunga 1,812 pounds rutile washed from 2,000 tons of gravel, and valued at £45, were produced during the year ending June 30, 1907. The rutile from gravel was probably saved as a by-product.

MOLYBDENUM.

The only production of molybdenite reported was a small lot of hand-picked ore, mined by the Crown Point Mining Company at Crown Point, near Lake Chelan, Washington, but it was not sold during 1907.

The small production is not due to lack of deposits, but to difficulties of concentration and an inactive demand.

No importation of ore is reported.

The use of molybdenum in steel seems to have made no headway in this country during the year, though it is still a matter of interest in Europe.

Several mining companies are interested in working the Maine deposits at Cooper, Tunk Pond, and near Machias.

A number of the Maine deposits were visited by the writer during the year, and a report was published in Bulletin 340–D of the United States Geological Survey. Notes upon wulfenite deposits at Alta, Utah, were given, and upon molybdenite at Corona, Cal.

VANADIUM.

Vanadium-iron oxide, from which ferrovanadium was made, was produced by the Vanadium Alloys Company at Newmire, Colo., and a small amount of sodium vanadate was produced by the Dolores Refining Company at Cedar, Colo. Both companies took steps toward a change in processes during the year.

The Vanadium Alloys Company used roscoelite as an ore, which it obtained from the United States Vanadium Company of Telluride, at Newmire. The roscoelite occurs in a rather fine-grained sandstone, which it colors a dull green.

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[a] Probably rutile mined from an original deposit, in distinction to that recovered from gravel.

The Dolores Refining Company obtained its vanadium product as a by-product in the manufacture of uranium salts from carnotite from ores obtained in the vicinity of the mill.

One lot of vanadium ore containing roscoelite was exported by J. C. Simmons from Newmire to England during the year. J. W. Westcott, Cedar, Colo., was also a producer of similar ore. All the ore is practically from surface excavations.

Discoveries of vanadinite (lead vanadate) were reported by the Copper Ridge Mining and Development Company at Magdalena, N. Mex., the Prassinos Copper Mining Company, 23 miles south of Casa Grande, Ariz., and from the Rothschild mine, 27 miles northwest of Dillon, Mont., but no output is known to have been made at either place.

The total quantity of ore sold or used in 1907 was 1,042 tons, which probably averaged little over 2 per cent vanadium, all produced at the places noted in southwestern Colorado, and was probably worth about $6,000 at the mines. In the performance of assessment work at various localities some ore was removed, which was left on the dumps.

The American Vanadium Company, of Pittsburg, carried on many experiments with regard to the application of vanadium to steel and cast-iron during the year, and test pieces of armor plate were made. The deposits from which they draw their supplies are at Cerro de Pasco, Peru.

No imports of vanadium ores were segregated by the customs service, but ores containing patronite (sulphide of vanadium) and other rare vanadium minerals were imported from Peru, and it is supposed that some vanadinite (lead vanadate) was imported from Spian.

URANIUM.

Little was done with uranium deposits in the United States during 1907. Assessment work was performed on many claims in Colorado, and a small amount of uranium salts were turned out by the Dolores Refining Company at Cedar, Colo., from carnotite obtained from surface excavations in the vicinity.

Oxide and salts of uranium, valued at $8,619, were imported during the year.

TANTALUM.

The price of tantalum dropped very greatly in 1906 and did not recover during 1907. The demand was very light, and prices were a matter of contract.

The only production reported was a few hundred pounds in South Dakota, and another lot of unknown weight and value, probably from North Carolina, which was shipped to France.

CHROMITE OR CHROMIC IRON ORE.

INTRODUCTION.

Chromite is widely distributed both in the southeastern and the western parts of the United States, where it is usually associated with certain basic igneous rocks, but it occurs at few localities in sufficient quantity to constitute an ore of chromium. In the States along the Atlantic slope no deposits of chrome ore are worked on a commercial scale, though it is probable that with the extension of railroad transportation some of the deposits will be exploited. The only active chromite mines in the United States are in California, where there has been a small production for many years.

Chrome ore is used principally in making ferrochrome alloys and for hardening steel, usually in combination with nickel, in the manufacture of armor plates. It is also used extensively in the manufacture of chromium salts for pigments. All the product of the California mines for several years has been used in the crude state for linings of copper furnaces.

The principal American markets for chromite are in the manufacturing States along the Atlantic slope, and these are supplied by importation, the chief sources of supply being Asiatic Turkey, and in recent years New Caledonia. Smaller quantities are produced in Russia, India, Australia, Greece, Canada, and Newfoundland.

PRODUCTION.

The total production of chromite in the Untited States during 1907 amounted to 290 long tons, valued at $5,640, all of it coming from California. It was used for furnace linings. When compared with the consumption of chrome ore in the United States, the domestic production becomes an insignificant factor. The demand is supplied from foreign sources, chiefly Asiatic Turkey and New Caledonia, the total imports in 1907 amounting to 41,989 long tons, valued at $491,925. The maximum production of the United States for any one year was in 1894, when the quantity mined was 3,680 long tons, valued at $53,231. This value was slightly exceeded in 1890 when the production amounted to 3,599 long tons, valued at $53,985. The production of chromite in the United States in 1885, 1890, 1895, 1900, and from 1903 to 1907, inclusive, is shown in the following table:

Production of chromite, 1885–1907, in long tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1885	2,700	$40,000	1904	123	$1,845
1890	3,599	53,985	1905	22	375
1895	1,740	16,795	1906	107	1,800
1900	140	1,400	1907	290	5,640
1903	150	2,250			

IMPORTS.

Chromium is imported into the United States both as crude ore and in various manufactured products. The quantities and values of the different forms of chromium, except chrome yellow, imported during the years 1901 to 1907, inclusive, are shown in the following table. The imports of chrome yellow are included in the chapter on mineral paints:

Chromate and bichromate of potash, chromic acid, and chrome ore imported and entered for consumption in the United States, 1901–1907.

Year.	Chromate and bichromate of potash.		Chromic acid.		Chrome ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Long tons.*		
1901	430,996	$29,224	53,462	$10,861	20,112	$363,108	$403,193
1902	....	....	90,817	11,115	39,570	582,597	593,712
1903	41,229	2,784	57,799	5,465	22,932	302,025	310,274
1904	26,053	1,817	87,721	10,505	24,227	348,527	360,849
1905	59,650	4,225	38,555	4,657	54,434	725,301	734,183
1906	30,098	2,124	1,307	331	43,441	557,594	560,049
1907	18,171	1,307	1,834	403	41,989	491,925	493,635

CANADIAN CHROMITE.

During the last few years the mining of chromite in the Dominion Canada has developed into an industry of some little importance, though the production in 1907 was not as large as that of either 1906 or 1905. The quantity and value of the chrome mined in the Dominion from 1902 to 1907, as reported by the Canadian Geological Survey, have been as follows:

Production of chromite in Canada, 1902–1907, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1902	900	$13,000	1905	8,575	$93,301
1903	3,383	33,830	1906	8,750	92,100
1904	6,074	67,146	1907	7,196	72,901

TIN.

By Frank L. Hess.

PRODUCTION.

In 1907, as in former years, the output of tin in the United States was insignificant when compared with the world's output, forming only about one-twentieth of 1 per cent of the world's total production for the year.

Eighty-nine tons of concentrates, valued at $33,285 and containing about 62 tons of metallic tin, were reported as produced. In addition several hundred pounds of metallic tin were produced in an experimental way by the Gertie Mining Company in South Dakota. A considerable quantity of tin ore, mostly low grade, which is not included in the production, was reported as mined and left on dumps.

Alaska.—The only tin produced in Alaska during 1907 was obtained from the Buck Creek placers. Two companies, the American Tin Mining Company and the North American Consolidated Company, carried on operations, but, as is frequently the case in this region, the season opened late and closed early, and storms interfered with work during the short summer. The tin ore of both companies was of high grade, averaging nearly 70 per cent metallic tin. The American Tin Mining Company reports that its stream tin carried $60 per ton in placer gold. Prospecting was carried on along Grouse Creek below the mouth of Buck Creek, and on veins on Potato Mountain, Ears Mountain, and Cape Mountain.

Adolph Knopf, of the United States Geological Survey, made a reconnaissance of the York tin region during the summer and discovered tin in a new combination with boron, magnesium, iron, and silica. Whether one or two new minerals are represented in the specimens obtained is undecided at this writing. The matter is important, as assayers have frequently reported tin from Ears Mountain ores when no cassiterite was to be found in them.

Washington.—Tin was discovered in Silver Hill, 10 or 12 miles southeast of Spokane, in 1906, but the matter was kept quiet until in 1907, when the discoverer, Mr. Richard Marsh, with Mr. Charles Robbins, began active work. One hundred and fifty tons of ore, estimated to carry 6 per cent of tin, were taken out and piled on the dump during the year.

South Dakota.—Considerable work was done at Tinton, and a great deal of low-grade ore is reported on the dumps of the Tinton Mining Company at Tinton, but no concentrates were made. Mr. Frank

Hebert, Oreville, and the Bear Gulch and Gold Hill Mining Company at Tinton produced some concentrates during the year, in part from placers. The Gertie Mining Company at Hill City, as already stated, produced a quantity of metallic tin in an experimental way. The Western Chemical Reduction Company produced concentrates in a test of ores. Prospecting was carried on at a number of other points.

Texas.—Further prospecting was carried on in the Franklin Mountains, 15 miles north of El Paso, but no serious attempt at exploitation has yet been made. A company known as the Florella Mining Company has taken over Mr. C. R. Morehead's holdings.

North Carolina and South Carolina.—The Blue Ridge Tin Corporation carried on development work during the year near the village of Kings Mountain and developed placers on the old Le Doux property, near the same place, which were worked to only a small extent. Mining was also carried on at Lincolnton, N. C., by the Piedmont Tin Mining Company, and at Gaffney, S. C., by Capt. S. S. Ross. An output was made by all three parties.

WORLD'S PRODUCTION.

As nearly as can be estimated from sources at this time available, the world's production of tin during 1907 seems to have been a little less than in 1906, approximately 113,000 short tons in 1907, against between 115,000 and 120,000 short tons in 1906.

World's production of tin in 1907, in short tons.

Southeastern Asiatic area:		
Federated Malay States [a]	54,242	
Banka [b]	12,675	
Billiton [b]	2,404	
Singkep [b]	437	
Siam [c]	4,645	
Burma [d]	108	
China [e]	4,500	
Japan [f]	30	
		79,041
Australia:		
Queensland [g]	3,454	
New South Wales [h]	1,883	
Victoria [i]	67	
Tasmania [j]	2,918	
Western Australia [k]	1,091	
		9,413

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[a] Min. Jour., London, vol. 83, 1908, p. 250.

[b] Editorial, Min. Jour., London, vol. 83, 1908, p. 601. The Banka figures are for the sales in Holland from February, 1907, to January, 1908. The Billiton figures are also for sales. Singkep figures are for the period from July, 1906, to July, 1907.

[c] Letter from John H. Heyl, Acting Director Royal Department Mines and Geology, Siam, March 11, 1908.

[d] "Capital" quoted in Min. Jour., London, vol. 83, 1908, p. 378.

[e] China has been estimated, and may be too high.

[f] Letter from T. Iki, Acting Director Imperial Geological Survey of Japan, February 26, 1908.

[g] Queensland Government Mining Journal, vol. 9, 1908, p. 123.

[h] Letter from E. F. Pittman, Under Secretary for Mines, March 24, 1908.

[i] Letter from S. Cohen, for Secretary of Mines and Forests, March 19, 1908.

[j] Progress of the Mineral Industry of Tasmania, quarters ending June 30 and December 31, 1907; p. 1 in each

[k] Supplement, Government Gazette, Western Australia, Perth, March 3, 1908, p. 684.

The Americas:		
Bolivia [a]	18,306	
United States	62	
Mexico [b]	4	
		18,372
Europe:		
Cornwall [c]	4,860	
Portugal [d]	16	
Spain, Austria, Germany (estimated)	100	
		4,976
Africa:		
Cape Colony [e]	140	
Transvaal [f]	878	
Other portions of South Africa [g]	432	
		1,450
Total		113,252

In spite of high prices during the first part of the year, the output did not increase owing to a number of reasons, principal among which are the working out of many placers in the Federated Malay States, Billiton, and Banka; drouth in the Australian tin fields, so that water for working was scarce; and lack of transportation facilities and of labor in Bolivia. The high export duty charged by the British Government upon all tin shipped from the Federated Malay States should probably also be given as a reason. This duty amounts ordinarily to 10 per cent, but certain favored companies pay only 8 per cent. The value of the metal is fixed by the latest quotations for Straits tin at Singapore. The duty on ore is 33⅓ per cent ad valorem, unless it is to be smelted in a country under British rule, in which case the duty is 10 per cent on the contained tin. These duties are levied whether the producing mine pays a profit or not. Thus a mine which might otherwise pay over 11 per cent profit can not be operated under the present impost. On the other hand, railroads and other roads built from the proceeds of the tax allow mining to be carried on in otherwise impossible places.

Forces which upheld production, besides the high prices of the early part of the year, were the efforts of the Dutch to obtain more coolies for working in their East Indian islands, the increased working of the Siamese mines, and the excellent work of the New South Wales dredgers.

IMPORTS.

During 1907 the United States imported for consumption 41,257 short tons of pig tin, valued, as entered, at $32,074,263, an average of 38.871 cents per pound. Taking the mean of the average monthly prices of tin as given by Mr. C. Mayer in the Annual Statistical

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[a] Min. Jour., London, vol. 83, 1908, p. 384.

[b] Letter from Señor Jose G. Aguilera, Director Instituto Geologico de Mexico, February 12, 1908.

[c] Editorial, Min. Jour., London, vol. 83, 1908, p. 601.

[d] Letter from J. F. N. Delgado, Director Geological Survey of Portugal, February 27, 1908.

[e] Letter from the Surveyor-General of Cape Colony, March 4, 1908. Tin content of ores estimated at 70 per cent owing to the high value given, about £104, per ton.

[f] Letter from the Director of the Geological Survey of Transvaal, March 2, 1908. Tin content of ores estimated at 60 per cent.

[g] Second annual statement of the trade and shipping of the colonies and territories forming the South African Customs Union, Cape Town, 1907. This figure is obtained by subtracting from the total exports from South Africa during the year the quantities given in the two letters referred to in the two notes immediately preceding. This quantity is assumed to carry 60 per cent of tin.

Report of the New York Metal Exchange for the year's average price, 38.169 cents is obtained, which is as close an agreement as could be expected between the figures.

The countries from which tin was imported, with the imports from each, are as follows:

Tin imported into the United States in calendar year 1907, by countries.

United Kingdom	short tons	24,923	$19,532,557
Netherlands	do	940	763,295
Other Europe	do	1,265	879,127
Straits Settlements	do	13,455	10,371,325
Other Asia and Oceania	do	601	479,465
Other countries	do	90	49,322
Total	do	41,274	32,075,091

The sources of the tin imported were as follows:

Sources of imports of tin into the United States in 1907, by countries.

Malay Peninsula	short tons	35,668
Australia	do	435
Banka and Billiton	do	813
England	do	1,714
China	do	246
Sundry	do	2,398
Total		41,274

In this table, which is largely adapted from the Annual Statistical Report of the New York Metal Exchange, referred to above, only the broader features of the import trade are shown. Nearly all the tin from Siam, Western Australia, Singkep, and part of the New South Wales, Billiton, and Queensland product is either smelted at or sold through Singapore and goes into the trade as "Straits tin." Bolivian tin ore and tin are usually sent to England and Germany for smelting or refining, and the product enters the American trade as from England or among the "sundry." It is known that several hundred tons of tin smelted in Bolivia were imported into this country by way of Liverpool. England also smelts Portuguese, Spanish, African, and East Indian or Malayan tin ores, so that it is impossible to say, from the data at hand, that the United States receives any Cornish tin.

Tin imported and entered for consumption in the United States, 1901 to 1907.

1901	short tons	37,280	$19,024,761
1902	do	42,522	21,263,337
1903	do	41,567	22,265,336
1904	do	41,472	22,356,895
1905	do	44,188	26,316,023
1906	do	50,477	37,447,315
1907	do	41,257	32,074,263

PRICES DURING 1907.

The market opened in January with tin at 41.80 cents per pound in lots of 10 tons or over, and fluctuated around 40 cents, generally above, until the middle of May. On the 16th of that month 44$\frac{3}{8}$ cents was reached, after which prices dropped steadily, with only slight recoveries, until on December 17 the price was 25.70 cents. The year closed with tin selling at 27$\frac{1}{4}$ cents.

The high prices of the first half of the year were undoubtedly a legacy from the speculative prices of 1906, when tin reached 48.5 cents on May 15. Tin lends itself peculiarly well to speculation, as the supply is definitely known; the mines are unable to respond quickly to the call of high prices, owing to the fact that but few have ore so blocked out that they can quickly increase their output by employing more miners, and their machinery is ordinarily sufficient only for a fixed output and can not increase that output on call; the alluvial mines are almost as difficult to manage in these regards as the lode mines, owing to the heavy overburden of barren ground in the East Indian fields; the sources of tin are mostly many thousand miles from the markets; the industries, chiefly the making of tin plate, need their supplies steadily, and must have them or lose heavily; and probably most important is the fact that the whole visible supply of metallic tin is of so small an amount at any one time that it can be much more readily handled by strong financial agencies than corn or wheat crops, in which "corners" have been successfully manipulated a number of times.

RECOVERED TIN.

The recovery of tin from scrap, dross, type-metal, babbitt and other friction metals, bronze, etc., is growing, and should grow even faster. The amount of tin wasted in tin cans that have been used and thrown away and the solder used on them is very great and is an extravagance which from a broad economic view is deplorable. Although the amount of tin ores to be drawn upon can not be as accurately measured as the coal deposits of the world, their exhaustion is as certain, and unless some now unrecognized substitute for tin is found, such as an economical method for the production of aluminum from clay might give, such saving will become compulsory.

During the year 16 companies recovered tin amounting to 1,662 short tons, valued at $914,404. Of this amount 93 tons was recovered and sold as tin, and 1,569 tons went into babbitt, bronze, type-metal, and other alloys.

A large but unknown recovery of tin from secondary sources was also made in Europe.

PLATINUM.

By David T. Day.

PRICES.

During the year 1907 the price of platinum declined in this country and abroad, according to the table which follows:

Prices of ingot platinum per troy ounce on the New York market in 1906 and 1907, by months.

1906.

January	$20.50	July	$26.00
February	25.00	August	26.00
March	25.00	September	33.00
April	25.00	October	33.00
May	25.00	November	38.00
June	26.00	December	38.00

1907.

January 1	$38.00	July 25	$27.00
February 20	37.00	August 1	27.50
March 20	36.00	August 15	28.00
April 1	34.00	September 20	27.00
April 10	32.00	October 20	26.50
May 10	31.00	December 1	26.00
May 20	28.00	December 15	25.50
May 25	26.00	December 31	25.00

PRODUCTION.

UNITED STATES.

Consistently with this decline in price, the production in the United States, which had risen with the high prices of the year before, showed a decline from 1,439 ounces of fine platinum, valued at $45,189, in 1906, to 357 ounces, valued at $10,589, in 1907. Of the 357 ounces produced in the United States in 1907, 300 ounces came from Butte, Del Norte, Humboldt, Placer, Plumas, Trinity, and Sacramento counties, in California, and 57 ounces from Coos, Curry, and Josephine counties, in Oregon. The domestic production since 1880 is shown in the following table:

Production of crude platinum in the United States, 1880–1900, and of refined metal from domestic ores in 1901–1907, in troy ounces.

Year.	Quantity.	Value.[a]	Year.	Quantity.	Value.[a]
1880	100	$400	1894	100	$600
1881	100	400	1895	150	900
1882	200	600	1896	163	944
1883	200	600	1897	150	900
1884	150	450	1898	225	3,375
1885	250	187	1899	300	1,800
1886	50	100	1900	400	2,500
1887	448	1,838	1901	1,408	27,526
1888	500	2,000	1902	94	1,874
1889	500	2,000	1903	110	2,080
1890	600	2,500	1904	200	4,160
1891	100	500	1905	318	5,320
1892	80	550	1906	1,439	45,189
1893	75	517	1907	357	10,589

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[a] The chief variations in price up to 1901 have been due to the quality of the crude grains. Since 1901, however, the average price for the refined metal has been given.

The decline in price in the United States increased the feeling of insecurity on the part of the platinum miners as to the value they would secure from their material, and rendered the search for platinum less active.

RUSSIA.

In Russia the contracts for practically the entire supply have been made for a number of years ahead, hence the fluctuations in price are of no significance in regard to the total annual output. Since 1894, inclusive, the production in Russia has been as follows:

Production of platinum in the Ural Mountains in the last few years, in troy ounces.

1894	203, 250	1904	190, 120
1896	200, 000	1905	200, 450
1898	203, 100	1906	210, 318
1900	212, 500	1907	142, 570
1903	226, 000		

Reports are frequent that an increasing proportion of the platinum in Russia is being mined by American interests, in accordance with the contracts as to price referred to above.

SOUTH AMERICA.

Continued interest is shown in the project of developing the platinum localities in the department of Cauca, Colombia, but development work has not proceeded to the point of any considerable product.

IMPORTS.

The imports are shown in the following table:

Platinum metals imported and entered for consumption in the United States, 1902–1907.

Year.	Platinum ore or crude platinum, including unmanufactured products, ingots, bars, sheets, and wire.		Manufactured products, including vases, retorts, etc.	Total.
	Quantity.	Value.	Value.	Value.
	Pounds.			
1902	7, 345	$1, 950, 362	$37, 618	$1, 987, 980
1903	7, 734	1, 920, 044	135, 889	2, 055, 933
1904				1, 879, 155
1905	7, 826	1, 985, 107	188, 156	2, 173, 263
1906	11, 494	3, 601, 120	187, 639	3, 788, 759
1907	6, 191	2, 508, 991	175, 651	2, 684, 642

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